A

NEW SYSTEM

OF

ARITHMETIC

AND

MATHEMATICS.

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PREFACE.

THE science of numbers is universally conceded to be an important one to every class in the community. In its cultivation and attainment *all* are deeply interested. The merchant, the mechanic, the professional man, the manufacturer, agriculturist, and laborer also require, in a greater or less degree, an acquaintance with its principles, on a correct understanding of which depend their prosperity in the prosecution of their several pursuits. The intricacies that have entered into this branch of necessary knowledge, have deterred many from undertaking its successful acquisition. The labor, the time, the study required to achieve a complete mastery over numerical science, interpose formidable objections to the system that has been so long established; which, although it commands respect for its age, yet its numberless defects furnish often almost insurmountable difficulties to its easy and rapid attainment.

To reduce the science of numbers to a greater degree of simplicity and facility of acquisition; to introduce into the plan of antiquated theories an easier, a surer, and quicker method of computation, is an important desidera-

tum, one that necessarily interests the actors in every department of business, and recommends itself to the favorable consideration of the community.

Many, who have in some measure thrown off the shackles of prejudice, and have endeavored to become reformers in this interesting field of enterprize, have failed substantially in accomplishing any very important results. They who would be improvers in oral, mental, and practical arithmetic and mathematics, have not as yet been able, with all their investigation, to present to the world a plan, by means of which these branches of science may be taught by a simplified method, and communicated with facility and precision to the understandings of the learners.

To remedy these defects, and to supply the means for facilitating the acquisition of arithmetical and mathematical knowledge, has engaged much of the time and attention of the author of this work: the persevering efforts made have been crowned with complete success; and the author begs leave to tender his congratulations to the public on the important improvement thereby made to the cause of arithmetical and mathematical science, whereby its acquisition is rendered more easy and more certain, requires much less time in its practical operations than heretofore, and reduces it to so simple a system, that even the most obtuse understanding can readily comprehend its principles. The saving of time is always an important item in the calculation of business; and the more rapidly correct computative results can be arrived at, the better for those who have embarked in their transaction.

This important improvement in the science of numbers, by which much time is saved and greater certainty ob-

tained, is now about to be introduced to the public, for their approbation and acceptance.

By way of exposition, it is necessary to state, that the whole of the principles of the science generally are contained and expressed in three words, viz:

INCREASE. DECREASE. EQUALITY.

Increase and decrease comprise addition, subtraction, multiplication, and division. Equality is the answer required, fixed by the question propounded under two different names, after which it is represented or expressed by a statement or equation, reduced by increase and decrease to the lowest term, equality, or the answer required. The science thus far concentrated, nothing remains but to simplify expressions or statements, to facilitate increase and decrease, which constitute the purport of the present publication.

It is expected that the fundamental principles of the science will be taught by gradual and persevering practice; it will liberate the minds of the teachers from the imperious necessity of propounding useless and irrelevant questions, and conduct the understanding along the avenues of knowledge, until the principles in which the science is based are fully understood. A progressive and reasonable instruction will enable teachers to make pupils of every grade in society perfectly acquainted, at the age of twelve years, with the science generally, adapted completely to the attainment and prosecution of mercantile, mechanical, and mathematical knowledge.

For a number of years it was the constant study of the author to bring into organic operation his simplified plan of instruction, as regulated by his fundamental principles.

This method of calculation affords the power of performing calculations in whole numbers, even when the question is composed of whole fractions, or number and fractions. By an easy process in the statement the fractions are rejected, the solution or calculation is performed by the pure proportion of all variation of measure, weight, money, &c., of the whole world, entirely by whole numbers and in an uninterrupted series. It teaches to obtain, by a succession of pure proportion, an answer to any arithmetical proportional question proposed. The rule of three, or the rule of proportion, named also the "golden rule," has not this power. By this rule we are often compelled to make four, five, and more statements before we are able to obtain the answer required. These proceedings, by the common rule of calculation with fractions, render the process circumstantial and confused to the scholar, and difficult to impress on his memory; but the rule of pure proportion teaches, in an easy, agreeable, and unavoidable manner, all the rules in general, as rule of three, tare, barter, fellowship, interest, reduction, loss and gain, exchange, and others; and even in the solution and statements of these questions, wherein it is now necessary to employ several of these rules, the rule of pure proportion will suffice; and it also performs the calculation always without interruption, and in whole numbers. By this rule all circumstantial calculation of fractional numbers are avoided, and, by the shortness in whole numbers, more agreeable too, than the circumstantial calculation with compound numbers; and it may be said, without hesitation, that the rule of pure proportion affords, in all business of common life, the same easiness as the decimal system does in the science of mathematics.

To enlarge this work by a long preface is not the intention of its author. It may speak for itself. It will be found, on examination, to do what it professes, viz., to teach an easy method of calculation, and to afford interesting and necessary knowledge to all men of business.

The pupil, even when he walks out for recreation, will find a subject for his thoughts and an agreeable little companion in this work. The amusing variation will afford to the scholar principles which will enable and animate him to perform questions hitherto unknown in any system of arithmetic; by the knowledge of pure proportion and true judgment, which this system of figures gives of fractions, the young pupil becomes, in the course of his studies, better prepared for the higher branches of mathematics, and the tutors will not have half the trouble to ingraft durable principles of calculation on his memory.

Finally, it may be observed, that the author of this method of calculation has shown a fixed rule, that will not be found in any system of arithmetic—a rule to find the pure proportion of all things. Besides, he has adjusted the necessary pure proportions in a few pages at the end of the work, and placed there also a few sheets of writing paper, for the purpose that new pure proportions, desired and found after this rule, may be neatly traced thereon.

THE AUTHOR.

PORTER'S NEW SYSTEM

OF

ARITHMETIC

AND

MATHEMATICS.

ARITHMETIC.

ARITHMETIC is the art or science of computing by numbers, and consists both in Theory and Practice. The Theory considers the nature and quality of numbers, and demonstrates the reason of practical operations. The Practice is that which shows the method of working by numbers, so as to be most useful and expeditious for business, and is comprised under five principal or fundamental rules, viz., *Notation or Numeration*, *Addition*, *Subtraction*, *Multiplication*, and *Division*; the knowledge of which is so necessary, that scarcely anything in life, and nothing in trade, can be done without it.

NUMERATION

TEACHETH to express any proposed number by these ten characters: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9—0 is called a cipher, and the rest figures, or digits; the relative value of which depends upon the place they stand in when joined together, beginning at the right hand, as in the following:

TABLE.

Hundreds of Millions.	Tens of Millions.	Millions.	Hundreds of Thousands.	Tens of Thousands.	Thousands.	Hundreds.	Tens.	Units.
9	8	7	6	5	4	3	2	1

Though the table consists of only nine places, yet it may be extended to more places at pleasure; as, after hundreds of millions, read thousands of millions, ten thousands of millions, hundred thousands of millions, billions, trillions, quadrillions, quintillions, sextillions, septillions, octillions, nonillions, decillions, undecillions, &c., as in the following example:

Quadrillions.	Trillions.	Billions.	Millions.	Units.
567 890	707 928	679 437	963 897	234 278

To write down numbers.

Rule. Write down the figures as their values are expressed, and supply any deficiency in the order with ciphers.

EXAMPLE.

Write down the following numbers in order:
Twenty-nine.
Two hundred and forty-six.
Six thousand nine hundred and one.
Eighty-four thousand three hundred and nine.
Six millions two hundred and sixty-eight.
Eighty-nine millions and ninety.
Four millions four hundred thousand.
Nine hundred and nine millions.
Seventy millions seventy thousand and seventy.
Twelve hundred and forty-six millions.

Eight hundred millions forty-four thousand.

Two thousand five hundred and forty-three millions, four hundred and thirty-one thousand.

Sixty-nine hundred, nine thousand and seventy-five.

SIMPLE ADDITION

Teacheth to collect numbers of the same denomination into one sum.

Rule. Place the numbers under each other, so that units may stand under units, tens under tens, and so on, and draw a line under them. Add the first row, or right-hand column, and find how many tens are contained in them; set down the remainder, and carry as many units or ones to the next column, as there are tens. In like manner, carry the tens of each column, till the whole be finished.

Proof. Begin at the top of the sum and reckon the figures downward, in the same manner as they were added upward; and, if it be right, this aggregate will be equal to the first: or, cut off the upper line of figures, and find the amount of the rest; then, if the amount and upper line, when added, be equal to the sum total, the work is right.

EXAMPLES.

(1.)	(2.)	(3.)
4	2 2	2 3 4 5
—	3 3	2 3 4 5
7	4 4	4 3 5 2
9	5 5	5 4 3 2
3	6 6	6 6 2 5
6	—	—
—	2 2 0	2 1 0 9 9
2 9	—	—
—		
2 5		
—		
2 9		
—		

(4.)

6	7	8	4
2	9	3	6
7	9	6	3
8	3	8	8
9	7	6	2
9	1	8	4

(5.)

6	4	7	9	4	3	9	7	2	8	7	2		
3	3	2	4	8	9	1	0	4	3	7	7		
6	4	8	2	7	6	6	4	3	1	1	1		
4	3	7	7	6	5	5	0	0	4	4	8		
3	9	4	6	8	9	2	8	9	2	7	9		
6	4	2	7	9	2	4	8	9	4	6	3		

Add the following sums:

(6.) 3784, 94, 96484, 04, 978649, 708.

(7.)

	3	7	8	4	
			9	4	
	9	6	4	8	4
			0	4	
9	7	8	6	4	9
			7	0	8

(8.)

9	4	7	8	3	7	
	6	7	2	1	0	
		3	8	9	4	
			7	8	6	
				9	4	
					8	

(9.)

				3
			4	7
		6	8	9
	3	9	7	4
5	4	7	9	6

(10.)

6	8	9	4	3	8	9	4	3	9	
8	4	3	7	7	3	0	1	6	4	
7	4	4	4	4	7	3	6	5	5	
3	9	9	2	6	7	9	4	7	6	
6	7	9	2	5	8	6	5	3	9	
7	9	2	1	1	2	4	7	2	6	
7	4	3	9	4	3	8	6	7	9	
8	1	8	8	6	7	6	3	8	3	
5	4	6	7	2	5	5	2	4	6	
4	8	9	3	6	9	3	8	4	9	
6	3	4	3	9	4	4	4	2	8	
4	0	0	0	3	9	3	7	8	6	
5	7	8	6	4	8	6	4	2	8	
4	6	3	9	4	8	7	6	4	7	
2	3	7	4	6	5	9	2	8	6	

11. A man borrowed of his neighbor 30 dollars at one time, 106 at another, 67 at another, and 37 at another: how much did he borrow in the whole? *Ans.* $240.

12. Four boys collected Chestnuts; John had 4096, Peter had 16784, Charles had 11590, and David 557; how many were there in the whole? *Ans.* 33027.

13. Four boys, on counting their apples, found Andrew had 67, Bennet 11 more than Andrew, Charles had 101, and Daniel had 16 more than Charles; how many apples had they all?

14. The deluge happened 2348 years before the birth of our Saviour, and America was discovered 1492 years after it; how many years intervened?

15. A farmer raised, in one year, 60 bushels of oats, 940 bushels of wheat, 370 of corn, and 80 bushels of potatoes; how many bushels did he raise in all?

16. A gentleman has six debtors, A, B, C, D, E, and F: A owes him 500 dollars; B owes him as much as A, and 90 dollars more; C owes him as much as A and B both; D owes him 67 dollars; E owes him as much as D and A's debts amount to; and F owes him 64 dollars more than the sum of A, B, C, D, and E's debts added together. What is the whole amount due him?

17. Four thousand two hundred and sixty-nine is one-sixth of some number; what is that number?

18. The ship Mary has just arrived from London, and one-fourth of her cargo is worth six thousand eight hundred and four dollars; what is the whole cargo worth?

19. Sir Isaac Newton was born in the year 1642, and died in the eighty-fifth of his age; in what year did he die?

20. If four bushels of wheat make one barrel of flour; and the price of wheat be one dollar per bushel; what will 400 barrels of flour cost?

21. King Charles the martyr was beheaded in the year 1648, and 130 years have elapsed since that period; what year is it now?

22. From the creation of the world to the flood was 1656 years; from thence to the building of Solomon's temple was 1336 years; thence to the birth of our Saviour was 1008 years; in what year was the birth of Christ?

Ans. 4000.

23. A gentleman owns one-eighth of a bank, and his part is worth 26,000 dollars; what is the value of the whole bank? *Ans.* $208,000.

24. The ship Lion sailed from Boston, bound to the port of Liverpool, with a cargo consisting of merchandize and specie; the value of the merchandize was 4444 dollars; the value of the merchandize was one-fourth of the value of the specie, and the value of the specie was one-half of the value of the ship; what was the value of the ship and cargo? *Ans.* $57,772.

25. If the cargo of a ship is worth 14,678 dollars, and the value of the cargo only one-sixth of the ship; what is the value of the ship and cargo? *Ans.* $102,746.

26. Suppose the distance from A to B is 44 miles, and the distance from A to B is one-half the distance from B to C, and the distance from B to C is one-third of the distance from C to D, and the distance from C to D is one-fourth of the distance from D to E, and the distance from D to E is one-sixth of the distance from E to F, and the distance from E to F is one-eighth of the distance from F to G; require the distance from A to G?

Ans. 58,476 *miles.*

SIMPLE SUBTRACTION

TEACHETH to take a less number from a greater of the same denomination, and thereby show the difference.

The greater is called the minuend, and the less the subtrahend.

Rule. Place the subtrahend, or less number, under the minuend or greater, and subtract units from units, tens from tens, and so on; if any figure of the subtrahend be greater than the corresponding one of the minuend, add ten to the upper figure, and then subtract the lower from the sum, set down the remainder, and carry one to the next figure of the subtrahend.

Proof. Add the remainder to the subtrahend, and if the sum is equal to the minuend, the work is right.

EXAMPLES.

	(1.)	(2.)
From	6 4 7 8 9	8 9 3 5 8 6 4 8
Take	3 2 4 3 4	8 8 3 5 6 4 3 8
Rem.	3 2 3 5 5	1 0 0 2 2 1 0

(3.)

7 4 3 9 4 3 4 6 7 8
6 2 7 3 1 7 2 8 4 6

1 1 6 6 2 6 1 8 3 2

(4.)

8 9 2 4 3 0 1 7 3
6 9 7 6 4 4 6 8 7

1 9 4 7 8 5 4 8 6

(5.)

6 4 9 7 9 3 8 5 6 7
4 6 8 3 6 8 3 7 9 8

(6.)

9 0 0 0 3 7 3 4
4 4 4 4 6 7 3 0

(7.)

4 8 6 7 3 8 6 4 9 7
4 7 9 8 6 4 3

(8.)

3 0 0 7 7 7 8 4 6 9 3
9 0 0 0 0 0

(9.)

4 8 6 3 5 9 4 6 8 7
3 0 0 0 0 0 0 1 8 6

(10.)

2 0 0 0 0 0 0 0 0
1 9 9 9 9 9 9 9 9

(11.)

1 8 6 4 3 7 0 0 0 0
1

(12.)

8 6 4 3 8 6 4 3 7 4 8
8 5 3 2 7 5 3 2 6 3 7

13. A man, having 478 dollars, lost 149 dollars in gambling; how many had he left? *Ans.* $329.

14. A gentleman bought a wagon for 108 dollars, and a harness for 42 dollars; what did the wagon cost him more than the harness? *Ans.* $66.

15. If a man have 2476 dollars, and he spend 675 dollars of it; how much will he have left? *Ans.* $1801.

16. A man bought a chaise for 214 dollars, and, to pay for it, gave a gig worth 47 dollars, and the rest in money; how much money did he pay? *Ans.* $167.

17. America was discovered by Christopher Columbus in 1492; how many years had elapsed when hostilities commenced in the revolutionary war, 1775? *Ans.* 283 *years.*

18. General George Washington was born in 1732, and died in 1799; what was his age? *Ans.* 67 *years.*

19. Sir Isaac Newton was born in 1642, and died in 1727; what was his age at the time of his death? *Ans.* 85 *years.*

20. A man in the year 1820 was 67 years of age; in what year was he born? *Ans.* 1753.

21. What is the difference between twice twenty-seven and three times forty-five? *Ans.* 81.

22. How much is 1200 greater than 365 and 721 added together? *Ans.* 114.

23. From New London to Philadelphia is 240 miles. Now, if a man should travel five days, from New London toward Philadelphia, at the rate of 39 miles each day, how far would he then be from Philadelphia? *Ans.* 45 *miles.*

24. What other number with these four, viz., 21, 32, 16, and 12, will make 100? *Ans.* 19.

25. A wine merchant bought 721 pipes of wine for 90,846 dollars, and sold 543 pipes thereof for 89,049 dollars; how many pipes has he remaining or unsold, and what do they stand him in? *Ans.* 178 *pipes, and* $1797.

26. Joe Careless received prize-money to the amount of 1000 dollars, after which he lays out 411 dollars 41 cents for a span of fine horses, and 123 dollars 40 cents for a gold watch and a suit of new clothes, besides 359 dollars and 50 cents he lost in gambling; how much will he have left after paying his landlord's bill, which amounts to 85 dollars and 11 cents? *Ans.* $20 58 *cts.*

SIMPLE MULTIPLICATION

Is a compendious way of adding numbers of the same name.

The number to be multiplied is called the multiplicand.

The number which multiplies is called the multiplier.

The number arising from the operation is called the product.

Rule. Place the multiplier under the multiplicand, and multiply the latter successively by the significant figures of the former; if the multiplier consists of more figures than one, place the right hand figure of each product under the figure from which it arises; then add the several products, and their sum is the product of both factors, and the answer required.

MULTIPLICATION TABLE.

2	times	1	are	2	3	times	1	are	3
2	"	2	"	4	3	"	2	"	6
2	"	3	"	6	3	"	3	"	9
2	"	4	"	8	3	"	4	"	12
2	"	5	"	10	3	"	5	"	15
2	"	6	"	12	3	"	6	"	18
2	"	7	"	14	3	"	7	"	21
2	"	8	"	16	3	"	8	"	24
2	"	9	"	18	3	"	9	"	27
2	"	10	"	20	3	"	10	"	30
2	"	11	"	22	3	"	11	"	33
2	"	12	"	24	3	"	12	"	36
2	"	13	"	26	3	"	13	"	39
2	"	14	"	28	3	"	14	"	42
2	"	15	"	30	3	"	15	"	45
2	"	16	"	32	3	"	16	"	48
2	"	17	"	34	3	"	17	"	51
2	"	18	"	36	3	"	18	"	54
2	"	19	"	38	3	"	19	"	57
2	"	20	"	40	3	"	20	"	60

4	times	1	are	4	5	times	1	are	5
4	"	2	"	8	5	"	2	"	10
4	"	3	"	12	5	"	3	"	15
4	"	4	"	16	5	"	4	"	20
4	"	5	"	20	5	"	5	"	25
4	"	6	"	24	5	"	6	"	30
4	"	7	"	28	5	"	7	"	35
4	"	8	"	32	5	"	8	"	40
4	"	9	"	36	5	"	9	"	45
4	"	10	"	40	5	"	10	"	50
4	"	11	"	44	5	"	11	"	55
4	"	12	"	48	5	"	12	"	60
4	"	13	"	52	5	"	13	"	65
4	"	14	"	56	5	"	14	"	70
4	"	15	"	60	5	"	15	"	75
4	"	16	"	64	5	"	16	"	80
4	"	17	"	68	5	"	17	"	85
4	"	18	"	72	5	"	18	"	90
4	"	19	"	76	5	"	19	"	95
4	"	20	"	80	5	"	20	"	100

6	times	1	are	6	7	times	1	are	7
6	"	2	"	12	7	"	2	"	14
6	"	3	"	18	7	"	3	"	21
6	"	4	"	24	7	"	4	"	28
6	"	5	"	30	7	"	5	"	35
6	"	6	"	36	7	"	6	"	42
6	"	7	"	42	7	"	7	"	49
6	"	8	"	48	7	"	8	"	56
6	"	9	"	54	7	"	9	"	63
6	"	10	"	60	7	"	10	"	70
6	"	11	"	66	7	"	11	"	77
6	"	12	"	72	7	"	12	"	84
6	"	13	"	78	7	"	13	"	91
6	"	14	"	84	7	"	14	"	98
6	"	15	"	90	7	"	15	"	105
6	"	16	"	96	7	"	16	"	112
6	"	17	"	102	7	"	17	"	119
6	"	18	"	108	7	"	18	"	126
6	"	19	"	114	7	"	19	"	133
6	"	20	"	120	7	"	20	"	140

8	times	1	are	8	9	times	1	are	9
8	"	2	"	16	9	"	2	"	18
8	"	3	"	24	9	"	3	"	27
8	"	4	"	32	9	"	4	"	36
8	"	5	"	40	9	"	5	"	45
8	"	6	"	48	9	"	6	"	54
8	"	7	"	56	9	"	7	"	63
8	"	8	"	64	9	"	8	"	72
8	"	9	"	72	9	"	9	"	81
8	"	10	"	80	9	"	10	"	90
8	"	11	"	88	9	"	11	"	99
8	"	12	"	96	9	"	12	"	108
8	"	13	"	104	9	"	13	"	117
8	"	14	"	112	9	"	14	"	126
8	"	15	"	120	9	"	15	"	135
8	"	16	"	128	9	"	16	"	144
8	"	17	"	136	9	"	17	"	153
8	"	18	"	144	9	"	18	"	162
8	"	19	"	152	9	"	19	"	171
8	"	20	"	160	9	"	20	"	180

10	times	1	are	10	11	times	1	are	11
10	"	2	"	20	11	"	2	"	22
10	"	3	"	30	11	"	3	"	33
10	"	4	"	40	11	"	4	"	44
10	"	5	"	50	11	"	5	"	55
10	"	6	"	60	11	"	6	"	66
10	"	7	"	70	11	"	7	"	77
10	"	8	"	80	11	"	8	"	88
10	"	9	"	90	11	"	9	"	99
10	"	10	"	100	11	"	10	"	110
10	"	11	"	110	11	"	11	"	121
10	"	12	"	120	11	"	12	"	132
10	"	13	"	130	11	"	13	"	143
10	"	14	"	140	11	"	14	"	154
10	"	15	"	150	11	"	15	"	165
10	"	16	"	160	11	"	16	"	176
10	"	17	"	170	11	"	17	"	187
10	"	18	"	180	11	"	18	"	198
10	"	19	"	190	11	"	19	"	209
10	"	20	"	200	11	"	20	"	220

12	times	1	are	12	13	times	1	"	13
12	"	2	"	24	13	"	2	"	26
12	"	3	"	36	13	"	3	"	39
12	"	4	"	48	13	"	4	"	52
12	"	5	"	60	13	"	5	"	65
12	"	6	"	72	13	"	6	"	78
12	"	7	"	84	13	"	7	"	91
12	"	8	"	96	13	"	8	"	104
12	"	9	"	108	13	"	9	"	117
12	"	10	"	120	13	"	10	"	130
12	"	11	"	132	13	"	11	"	143
12	"	12	"	144	13	"	12	"	156
12	"	13	"	156	13	"	13	"	169
12	"	14	"	168	13	"	14	"	182
12	"	15	"	180	13	"	15	"	195
12	"	16	"	192	13	"	16	"	208
12	"	17	"	204	13	"	17	"	221
12	"	18	"	216	13	"	18	"	234
12	"	19	"	228	13	"	19	"	247
12	"	20	"	240	13	"	20	"	260

14	times	1	are	14	15	times	1	are	15
14	"	2	"	28	15	"	2	"	30
14	"	3	"	42	15	"	3	"	45
14	"	4	"	56	15	"	4	"	60
14	"	5	"	70	15	"	5	"	75
14	"	6	"	84	15	"	6	"	90
14	"	7	"	98	15	"	7	"	105
14	"	8	"	112	15	"	8	"	120
14	"	9	"	126	15	"	9	"	135
14	"	10	"	140	15	"	10	"	150
14	"	11	"	154	15	"	11	"	165
14	"	12	"	168	15	"	12	"	180
14	"	13	"	182	15	"	13	"	195
14	"	14	"	196	15	"	14	"	210
14	"	15	"	210	15	"	15	"	225
14	"	16	"	224	15	"	16	"	240
14	"	17	"	238	15	"	17	"	255
14	"	18	"	252	15	"	18	"	270
14	"	19	"	266	15	"	19	"	285
14	"	20	"	280	15	"	20	"	300

16	times	1	are	16	17	times	1	"	17
16	"	2	"	32	17	"	2	"	34
16	"	3	"	48	17	"	3	"	51
16	"	4	"	64	17	"	4	"	68
16	"	5	"	80	17	"	5	"	85
16	"	6	"	96	17	"	6	"	102
16	"	7	"	112	17	"	7	"	119
16	"	8	"	128	17	"	8	"	136
16	"	9	"	144	17	"	9	"	153
16	"	10	"	160	17	"	10	"	170
16	"	11	"	176	17	"	11	"	187
16	"	12	"	192	17	"	12	"	204
16	"	13	"	208	17	"	13	"	221
16	"	14	"	224	17	"	14	"	238
16	"	15	"	240	17	"	15	"	255
16	"	16	"	256	17	"	16	"	272
16	"	17	"	272	17	"	17	"	289
16	"	18	"	288	17	"	18	"	306
16	"	19	"	304	17	"	19	"	323
16	"	20	"	320	17	"	20	"	340

18	times	1	are	18	19	times	1	are	17
18	"	2	"	36	19	"	2	"	38
18	"	3	"	54	19	"	3	"	57
18	"	4	"	72	19	"	4	"	76
18	"	5	"	90	19	"	5	"	95
18	"	6	"	108	19	"	6	"	114
18	"	7	"	126	19	"	7	"	133
18	"	8	"	144	19	"	8	"	152
18	"	9	"	162	19	"	9	"	171
18	"	10	"	180	19	"	10	"	190
18	"	11	"	198	19	"	11	"	209
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18	"	16	"	288	19	"	16	"	304
18	"	17	"	306	19	"	17	"	323
18	"	18	"	324	19	"	18	"	342
18	"	19	"	342	19	"	19	"	361
18	"	20	"	360	19	"	20	"	380

20	times	1	are	20	20	times	11	are	220
20	"	2	"	40	20	"	12	"	240
20	"	3	"	60	20	"	13	"	260
20	"	4	"	80	20	"	14	"	280
20	"	5	"	100	20	"	15	"	300
20	"	6	"	120	20	"	16	"	320
20	"	7	"	140	20	"	17	"	340
20	"	8	"	160	20	"	18	"	360
20	"	9	"	180	20	"	19	"	380
20	"	10	"	200	20	"	20	"	400

EXAMPLES.

(1.)

4 3 4 1 2 3 4 3
2

8 6 8 2 4 6 8 6

(2.)

3 5 6 8 3 7 5
3

1 0 7 0 5 1 2 5

(3.)

6 4 7 8 4 6 5 6
4

(4.)

8 6 9 6 4 6 7 9 7
2 6

(5.)

6 9 7 4 3 9 7 9 4

6 4 8

(6.)

9 8 7 6 5 4 3 2 1 0

4 9 8 7 6

7. What is the value of 29 pairs of men's shoes, at 1 dollar 51 cents per pair? *Ans.* $43,79 *cts.*

8. What cost 140 reams of paper, at 2 dollars 35 cents per ream? *Ans.* $329.

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Teacheth to find how often one number is contained in another of the same name.

The number to be divided is called the dividend.

The number by which to divide is called the divisor.

The number of times the divisor is contained in the dividend is called the quotient.

The remainder, if there be any, will always be less than the divisor.

Rule. On the right and left of the dividend draw a curved line, and write the divisor on the left hand, and the quotient, as it arises, on the right. Find how many

times the divisor is contained in as many figures as are necessary in the dividend, and write the number in the quotient.

Multiply the divisor by the quotient figure, and set the product under that part of the dividend used.

Subtract the product last found from that part of the dividend under which it is placed, and to the right hand of the remainder bring down the next figure of the dividend; divide this number as before, and so on, till the whole is finished. If it be necessary to bring down more figures than one to the remainder, in order to make it as large as the divisor, a cipher must be written in the quotient for every figure so brought down, till the number be sufficient to contain the divisor.

Proof. Multiply the quotient by the divisor, and to the product add the remainder, and the sum will be equal to the dividend, if the work is right. When there are ciphers annexed to the divisor, cut off the ciphers from it, and the same number of digits from the dividend, then divide the remaining figures by each other, as usual, the quotient is the answer;—and what remains, placed before the figures cut off, is the true remainder.

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(1.)	(2.)
4)568743864	6)6894868
142185966	1149144—4 rem.

(3)	(4.)
9)9763856	12)8764864
1084872—8	730405—4

(5.)

```
4)87643(21910
  8      4
  -      -
  7    87643 proof
  4
  -
 36
 36
 --
  4
  4
  -
  3
```

(6.)

```
8)97643(12205
  8
  -
 17
 16
 --
 16
 16
 --
 43
 40
 --
  3 remainder.
```

(7.)

```
14)6898(492
   56
   --
  129
  126
  ---
   38
   28
   --
   10
```

(8.)

```
36)87436(2428
   72
   --
  154
  144
  ---
  103
   72
   --
  316
  288
  ---
   28
```

(9.)

```
40)7364(184
   40
   --
  336
  320
  ---
  164
  160
  ---
    4
```

(10.)

```
360)978964(2302
    720
    ---
   2589
   2580
   ----
    964
    720
    ---
    244
```

(11.)

```
3956)34585539543(8742552
     31648
     -----
      29375
      27692
      -----
       16833
       15824
       -----
        10099
         7912
         ----
        21875
        19780
        -----
         20954
         19780
         -----
          11743
           7912
           ----
           3831
```

(12.)

```
6,00)74389486,00(12398247
     6
     -
      14
      12
      --
       23
       18
       --
        58
        54
        --
         49
         48
         --
          14
          12
          --
           28
           24
           --
            46
            42
            --
             4
```

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14. If 383,040 dollars were equally divided among 456 men, how much would each receive? *Ans.* $840.

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16. Sold a farm, containing 365 acres of land, for 8395 dollars; how much was it per acre? *Ans.* $23.

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18. Bought a piece of cloth for 363 dollars, at 3 dollars per yard; how many yards in the said piece of cloth? *Ans.* 121.

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20. A regiment of soldiers, consisting of 500 men, are allowed 1000 pounds of pork per day; how much is each man's part? *Ans.* 2 *lbs.*

21. Write down 4617, multiply it by 12, divide the product by 9, and add 365 to the quotient, then from that sum subtract 5521, and the remainder will be just one thousand. Try it and see.

TABLE OF MONEY, WEIGHTS, MEASURES, &c.

1. *Federal Money.*

10 mills (*m.*) make	1 cent, marked	*c.*
10 cents,	1 dime,	*d.*
10 dimes,	1 dollar,	$.
10 dollars,	1 eagle,	E.

2. *Sterling Money.*

4 farthings make	1 penny,	*d.*
12 pence,	1 shilling,	*s.*
20 shillings,	1 pound,	£.

3. *Troy Weight.*

24 grains (*gr.*) make	1 pennyweight, marked	*dwt.*
20 pennyweights,	1 ounce,	*oz.*
12 ounces,	1 pound,	*lb.*

4. *Avoirdupois Weight.*

16 drachms (*dr.*)	1 ounce,	*oz.*
16 ounces,	1 pound,	*lb.*
28 pounds, 1 quarter of a hundred weight,		*qr.*
4 quarters,	1 hundred weight,	*cwt.*
20 hundred weight,	1 ton.	*T.*

By this weight are weighed all coarse and drossy goods, grocery wares, and all metals except gold and silver.

5. *Apothecaries Weight.*

20 grains (*gr.*) make	1 scruple,	℈
3 scruples,	1 dram,	ʒ
8 drachms,	1 ounce,	℥
12 ounces,	1 pound,	℔

Apothecaries use this weight in compounding their medicines.

6. *Cloth Measure.*

4 nails (*na.*) make	1 quarter of a yard,	*qr.*
4 quarters,	1 yard,	*yd.*
3 quarters,	1 Ell Flemish,	*E. Fl.*
5 quarters,	1 Ell English,	*E. E.*
6 quarters,	1 Ell French,	*E. Fr.*

7. *Dry Measure.*

2 pints, (*pt.*) make	1 quart,	*qt.*
8 quarts,	1 peck,	*pk.*
4 pecks,	1 bushel,	*bu.*

This measure is applied to grain, beans, flax-seed, salt, oats, oysters, coal, &c.

8. *Wine Measure.*

4 gills (*gi.*) make	1 pint,	*pt.*
2 pints,	1 quart,	*qt.*
4 quarts,	1 gallon,	*gal.*
31½ gallons,	1 barrel,	*bl.*
42 gallons,	1 tierce,	*tier.*
63 gallons,	1 hogshead,	*hhd.*
2 hogsheads,	1 pipe,	*p.*
2 pipes,	1 tun,	*T.*

All brandies, spirits, mead, vinegar, oil, &c., are measured by wine measure. *Note.* 231 solid inches make a gallon.

9. *Long Measure.*

3 barley corns (*b. c.*) make	1 inch, marked	*in.*
12 inches,	1 foot,	*ft.*
3 feet,	1 yard,	*yd.*
5½ yards,	1 rod, pole, or perch,	*rd.*
40 rods,	1 furlong,	*fur.*
8 furlongs,	1 mile,	*m.*
3 miles,	1 league,	*lea.*
69½ statute miles.	1 degree, on the earth,	

360 degrees, the circumference of the earth.

The use of long measure is to measure the distance of places, or any other thing where length is considered without regard to breadth.

N. B. In measuring the height of horses, 4 inches make 1 hand. In measuring depths, 6 feet make 1 fathom or French toise. Distances are measured by a chain, four rods long, containing one hundred links.

10. *Land, or Square Measure.*

144 square inches make	1 square foot.
9 square feet make	1 square yard.
30¼ square yards, or 272¼ square feet,	1 square rod.
40 square rods,	1 square rood.
4 square roods,	1 square acre.
640 square acres,	1 square mile.

11. *Solid, or Cubic Measure.*

1728 solid inches make	1 solid foot.
40 feet of round timber, or 50 feet of hewn timber,	1 ton or load.
128 solid feet, or 8 feet long, 4 wide, and 4 high,	1 cord of wood

All solids, or things that have length, breadth, and depth, are measured by this measure. N. B. The wine gallon contains 231 solid or cubic inches, and the beer gallon 282. A bushel contains 2150,42 solid inches.

12. *Time.*

60 seconds (*S.*) make	1 minute, marked	*M.*
60 minutes,	1 hour,	*h.*
24 hours,	1 day,	*d.*
7 days,	1 week,	*w.*
4 weeks,	1 month,	*mo.*
13 months, 1 day and 6 hours,	1 Julian year,	*yr.*

Thirty days hath September, April, June and November; February twenty-eight alone, all the rest have thirty-one.

N. B. In Bissextile, or leap year, February hath 29 days.

13. *Circular Motion.*

60 seconds (″) make	1 minute,	′
60 minutes,	1 degree,	°
30 degrees,	1 sign,	*S.*

12 signs, or 360 degrees, the whole great circle of the Zodiac.

LIQUID MEASURE.						CLOTH MEASURE						
Tun. T.	Pipes. pi or bt.	Hogsheads. hhd.	Gallons. gal.	Quarts. qt.	Pints. pt.	Yard. yd.	Quarters. qr.	Nail. na.	Inches. in.		Ell.	Yard. yd.
1	2	4	252	1008	2016	1	4	16	36	Flemish	4	3
	1	2	126	504	1008		1	4	9	English	4	5
		1	63	252	504			1	2¼	Hamburg	8	5
			1	4	8							
				1	2							

SQUARE MEASURE.

Mile.	Acre	Rood	Chain.	Perch.	Yard.	Foot.	Link.	Inch.	Barley Corn.
1	640	2560	6400	102400	3097600	2787400	64000000	40144890	37130406400
	1	4	10	160	4840	43560	100000	6272640	56453760
		1	"	40	1210	10890	"	1568160	14113440
			1	"	"	"	10000	"	"
				1	30¼	272¼	"	39204	352836
				4	121	1089	"	"	"
					1	9	"	1296	11664
						1	"	144	432
								1	9

DRY MEASURE.

Bushel. bu.	Peck. P.	Quart. qt.	Pint. pt.
1	4	32	64
	1	8	16
		1	2

MOTION, OR CIRCLE MEASURE.

Circle.	Sine.	Degree. °	Minute. ′	Second. ″
1	12	360	21600	1296000
	1	30	1800	108000
		1	60	3600
			1	60

DIVISION OF TIME:

Year.	Months.	Weeks.	Days.	Hours.	Minutes.	Seconds.
1	12	52	365	8760	525600	19536000
	1	4				
		1	7			
			1	24	1440	86400
				1	60	3600
					1	60

365 days 6 hours
13 lunar months, 1 day, 6 hours } 1 year nearly.

18	times	1	are	18	19	times	1	are	17
18	"	2	"	36	19	"	2	"	38
18	"	3	"	54	19	"	3	"	57
18	"	4	"	72	19	"	4	"	76
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18	"	13	"	234	19	"	13	"	247
18	"	14	"	252	19	"	14	"	266
18	"	15	"	270	19	"	15	"	285
18	"	16	"	288	19	"	16	"	304
18	"	17	"	306	19	"	17	"	323
18	"	18	"	324	19	"	18	"	342
18	"	19	"	342	19	"	19	"	361
18	"	20	"	360	19	"	20	"	380
20	times	1	are	20	20	times	11	are	220
20	"	2	"	40	20	"	12	"	240
20	"	3	"	60	20	"	13	"	260
20	"	4	"	80	20	"	14	"	280
20	"	5	"	100	20	"	15	"	300
20	"	6	"	120	20	"	16	"	320
20	"	7	"	140	20	"	17	"	340
20	"	8	"	160	20	"	18	"	360
20	"	9	"	180	20	"	19	"	380
20	"	10	"	200	20	"	20	"	400

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(1.)

4 3 4 1 2 3 4 3
2

8 6 8 2 4 6 8 6

(2.)

3 5 6 8 3 7 5
3

1 0 7 0 5 1 2 5

(3.)

6 4 7 8 4 6 5 6
4

(4.)

8 6 9 6 4 6 7 9 7
2 6

(5.)

6 9 7 4 3 9 7 9 4

6 4 8

(6.)

9 8 7 6 5 4 3 2 1 0

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  -      -
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  -
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  36
  --
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   4
   -
   3
```

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  8
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  16
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  --
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   40
   --
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```
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   56
   --
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  126
  ---
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   28
   --
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```

(8.)

```
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   72
   --
  154
  144
  ---
  103
   72
   --
  316
  288
  ---
   28
```

(9.)

```
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   40
   --
  336
  320
  ---
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  ---
    4
```

(10.)

```
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    720
    ---
   2589
   2580
   ----
    964
    720
    ---
    244
```

(11.)

```
3956)34585539543(8742552
     31648
     -----
     29375
     27692
     -----
     16833
     15824
     -----
     10099
      7912
     -----
     21875
     19780
     -----
     20954
     19780
     -----
     11743
      7912
     -----
      3831
```

(12.)

```
6,00)74389486,00(12398247
     6
     -
     14
     12
     --
     23
     18
     --
     58
     54
     --
     49
     48
     --
     14
     12
     --
     28
     24
     --
     46
     42
     --
      4
```

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16 drachms (*dr.*)	1 ounce,	*oz.*
16 ounces,	1 pound,	*lb.*
28 pounds, 1 quarter of a hundred weight,		*qr.*
4 quarters,	1 hundred weight,	*cwt.*
20 hundred weight,	1 ton.	*T.*

By this weight are weighed all coarse and drossy goods, grocery wares, and all metals except gold and silver.

5. *Apothecaries Weight.*

20 grains (*gr.*) make	1 scruple,	℈
3 scruples,	1 dram,	ʒ
8 drachms,	1 ounce,	℥
12 ounces,	1 pound,	℔

Apothecaries use this weight in compounding their medicines.

6. *Cloth Measure.*

4 nails (*na.*) make	1 quarter of a yard,	*qr.*
4 quarters,	1 yard,	*yd.*
3 quarters,	1 Ell Flemish,	*E. Fl.*
5 quarters,	1 Ell English,	*E. E.*
6 quarters,	1 Ell French,	*E. Fr.*

7. *Dry Measure.*

2 pints, (*pt.*) make	1 quart,	*qt.*
8 quarts,	1 peck,	*pk.*
4 pecks,	1 bushel,	*bu.*

This measure is applied to grain, beans, flax-seed, salt, oats, oysters, coal, &c.

8. *Wine Measure.*

4 gills (*gi.*) make	1 pint,	*pt.*
2 pints,	1 quart,	*qt.*
4 quarts,	1 gallon,	*gal.*
31½ gallons,	1 barrel,	*bl.*
42 gallons,	1 tierce,	*tier.*
63 gallons,	1 hogshead,	*hhd.*
2 hogsheads,	1 pipe,	*p.*
2 pipes,	1 tun,	*T.*

All brandies, spirits, mead, vinegar, oil, &c., are measured by wine measure. *Note.* 231 solid inches make a gallon.

9. *Long Measure.*

3 barley corns (*b. c.*) make	1 inch, marked	*in.*
12 inches,	1 foot,	*ft.*
3 feet,	1 yard,	*yd.*
5½ yards,	1 rod, pole, or perch,	*rd.*
40 rods,	1 furlong,	*fur.*
8 furlongs,	1 mile,	*m.*
3 miles,	1 league,	*lea.*
69½ statute miles.	1 degree, on the earth,	

360 degrees, the circumference of the earth.

The use of long measure is to measure the distance of places, or any other thing where length is considered without regard to breadth.

N. B. In measuring the height of horses, 4 inches make 1 hand. In measuring depths, 6 feet make 1 fathom or French toise. Distances are measured by a chain, four rods long, containing one hundred links.

10. *Land, or Square Measure.*

144 square inches make	1 square foot.
9 square feet make	1 square yard.
30¼ square yards, or 272¼ square feet,	1 square rod.
40 square rods,	1 square rood.
4 square roods,	1 square acre.
640 square acres,	1 square mile.

11. *Solid, or Cubic Measure.*

1728 solid inches make	1 solid foot.
40 feet of round timber, or 50 feet of hewn timber,	1 ton or load.
128 solid feet, or 8 feet long, 4 wide, and 4 high,	1 cord of wood

All solids, or things that have length, breadth, and depth, are measured by this measure. N. B. The wine gallon contains 231 solid or cubic inches, and the beer gallon 282. A bushel contains 2150,42 solid inches.

12. *Time.*

60 seconds (*S.*) make	1 minute, marked	*M.*
60 minutes,	1 hour,	*h.*
24 hours,	1 day,	*d.*
7 days,	1 week,	*w.*
4 weeks,	1 month,	*mo.*
13 months, 1 day and 6 hours,	1 Julian year,	*yr.*

Thirty days hath September, April, June and November; February twenty-eight alone, all the rest have thirty-one.

N. B. In Bissextile, or leap year, February hath 29 days.

13. *Circular Motion.*

60 seconds (″) make	1 minute,	′
60 minutes,	1 degree,	°
30 degrees,	1 sign,	*S.*

12 signs, or 360 degrees, the whole great circle of the Zodiac.

LIQUID MEASURE.						CLOTH MEASURE						
Tun. T.	Pipes. pi or bt.	Hogsheads. hhd.	Gallons. gal.	Quarts. qt.	Pints. pt.	Yard. yd.	Quarters. qr.	Nail. na.	Inches. in.		Ell.	Yard. yd.
1	2	4	252	1008	2016	1	4	16	36	Flemish	4	3
	1	2	126	504	1008		1	4	9	English	4	5
		1	63	252	504			1	$2\frac{1}{4}$	Hamburg	8	5
			1	4	8							
				1	2							

SQUARE MEASURE.

Mile.	Acre	Rood.	Chain.	Perch.	Yard.	Foot.	Link.	Inch.	Barley Corn.
1	640	2560	6400	102400	3097600	2787400	64000000	40144890	37130406400
	1	4	10	160	4840	43560	100000	6272640	56453760
		1	"	40	1210	10890	"	1568160	14113440
			1	"	"	"	10000	"	"
				1	$30\frac{1}{4}$	$272\frac{1}{4}$	"	39204	352836
				4	121	1089	"	"	"
					1	9	"	1296	11664
						1	"	144	432
								1	9

DRY MEASURE.

Bushel. bu.	Peck. P.	Quart. qt.	Pint. pt.
1	4	32	64
	1	8	16
		1	2

MOTION, OR CIRCLE MEASURE.

Circle.	Sine.	Degree. °	Minute. ′	Second. ″
1	12	360	21600	1296000
	1	30	1800	108000
		1	60	3600
			1	60

DIVISION OF TIME:

Year.	Months.	Weeks.	Days.	Hours.	Minutes.	Seconds.
1	12	52	365	8760	525600	19536000
	1	4				
		1	7			
			1	24	1440	86400
				1	60	3600
					1	60

365 days 6 hours
13 lunar months, 1 day, 6 hours } 1 year nearly.

TROY WEIGHT.

Pound. lb.	Ounce. oz.	Pennyweight. dwt.	Grain. gr.
1	12	240	5760
	1	20	480
		1	24

By this weight gold, silver, jewels, and liquors, are weighed.

AVOIRDUPOIS WEIGHT.

Ton. T.	Hundred weight. cwt.	Quarter. qr.	Pound. lb.	Ounce. oz.	Drachm. dr.
1	20	80	2240	35840	573440
	1	4	112	1792	28672
		1	28	448	7468
			1	16	256
				1	16

By this weight are weighed things of a coarse drossy nature, that are bought and sold by weight; and all metals, but silver and gold.

APOTHECARIES WEIGHT.

Pound.	Ounce.	Drachm.	Scruple.	Grain.
1	12	96	288	5760
	1	8	24	480
		1	3	60
			1	20

By this weight apothecaries mix their medicines, but buy and sell by avoirdupois weight.

THINGS BOUGHT AND SOLD BY THE DOZEN, GROSS, &c.

Great gross. g. gro.	Common gross. gro.	Dozen. doz.	Particulars. prs.
1	12	144	1728
	1	12	144
		1	12

LONG MEASURE.

Circle.	Degree.	League.	Geographical miles.	Statute miles.	Furlong.	Chain.	Perch.	Yard.	Foot.	Link.	Inch.	Barleycorn.
1	60	7200	21600	25025	172800	1728000	6912000	38016000	114048000	1728000000	13683760000	4105728000
	1	20	60	69½	480	4800	19200	105600	316800	480000	3801600	11404800
	2	1		139								
			3	"	24	240	960	5280	15840	24000	190080	5700240
			1	"	8	80	320	1760	5280	8000	63360	190080
				"	1	10	40	220	660	1000	7920	28760
						1	4	22	66	100	792	2376
							1	5½	16½	25	198	594
							2	11	33	50	396	1188
								1	3	"	36	108
									1	"	12	36
										"	1	3

A hand is a measure of four inches, commonly used by horse dealers.
A fathom is a measure of six feet, by which the depths of water or wells and mines are measured.

COMPOUND ADDITION

TEACHETH to collect numbers of different denominations into one total.

Rule. Arrange the numbers so that those of the same denomination may stand directly under each other, and draw a line under them.

Add the numbers in the lowest denomination together, and find how many units of the next higher denomination are contained in their sum.

Write down the remainder, and carry the units to the next higher denomination, and proceed thus to the end.

EXAMPLES.

FEDERAL MONEY.

(1.)

$	cts.	m.
174	74	3
186	67	5
226	89	8
164	40	9
752	72	5

(2.)

$	cts.	m.
396	54	3
876	58	6
786	56	2
375	59	8
967	50	6
987	37	4
469	25	8
357	37	5
223	22	2
364	67	4

STERLING MONEY.

(3.)

£	s.	d.	qr.
48	13	6	2
96	15	9	3
27	18	10	2
33	9	8	3
86	2	7	3
48	5	6	3

(4.)

£	s.	d.
475	18	6
337	16	9
200	15	3
496	7	7
462	7	10
934	9	7
333	3	3

TROY WEIGHT.

(5.)

lb.	*oz.*	*dwt.*	*gr.*
48	7	14	17
36	11	18	23
84	10	17	20
68	4	13	13
37	7	17	17
96	8	16	18

(6.)

lb.	*oz.*	*dwt.*	*gr.*
99	11	19	23
107	5	8	22
209	9	17	21
200	8	16	20
300	7	15	19
666	6	16	16

AVOIRDUPOIS WEIGHT.

(7.)

T.	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*
350	14	2	19	14	13
680	19	3	26	13	9
356	18	1	27	15	15
220	12	2	20	14	14
386	17	3	13	13	13
376	14	2	18	15	13

(8.)

cwt.	*qr.*	*lb.*
60	2	26
45	3	18
33	3	3
44	2	18
67	3	14
58	1	16

APOTHECARIES WEIGHT.

(9.)

lb.	*oz.*	*dr.*	*sc.*	*gr.*
6	6	7	2	16
9	9	6	1	18
60	10	7	2	13
44	3	3	1	17
60	8	6	1	14

(10.)

lb.	*oz.*	*dr.*	*sc.*	*gr.*
25	11	7	2	19
60	10	6	1	18
64	8	4	2	16
80	7	3	1	15
35	6	2	2	14

CLOTH MEASURE.

(11.)

yd.	*qr.*	*na.*
687	3	3
486	3	2
386	2	3
489	2	1
643	3	3

(12.)

E. Fr.	*qr.*	*na.*
475	2	3
600	3	2
800	3	1
68	1	1
968	2	2

WINE MEASURE.

(13.)

tun	*hhd.*	*gal.*	*qt.*	*pt.*
500	1	60	3	1
674	3	56	2	1
387	2	61	3	1
837	2	44	2	1
444	3	25	3	1

(14.)

hhd.	*gal.*	*qt.*
75	45	3
44	61	2
37	43	3
99	60	2
77	40	0

ALE AND BEER MEASURE.

(15.)

hhd	*gal.*	*qt.*	*pt.*
55	55	3	1
38	44	2	0
48	36	2	0
36	47	1	1
60	60	3	1
38	44	2	1

(16.)

hhd.	*gal.*	*qt.*	*pt.*
80	47	3	2
63	39	2	0
42	24	3	1
69	29	2	1
75	48	3	1
87	36	1	0

DRY MEASURE.

(17.)

qr.	*bu.*	*pk.*	*qt.*
43	7	3	7
63	6	2	6
43	5	1	5
87	5	2	5
60	3	1	3
44	6	2	4

(18.)

chal.	*bu.*	*pk.*	*qt.*
675	31	2	3
743	29	2	7
647	26	3	6
434	28	0	4
386	34	1	3
487	22	2	6

LONG MEASURE.

(19.)

deg.	*mil.*	*fur.*	*po.*	*ft.*	*in.*	*b.c.*
560	56	7	30	15	9	2
374	50	6	26	14	8	2
246	46	5	24	13	9	0
222	37	4	33	12	4	2
460	28	3	28	11	6	1

LAND MEASURE.

(20.)			(21.)		
acr.	*roo.*	*pr.*	*acr.*	*roo.*	*pr.*
645	3	29	860	3	21
742	2	28	643	2	20
468	3	27	375	1	16
375	2	29	479	3	12
269	1	20	786	2	10
377	3	14	111	1	11

TIME.

years	*days*	*hours*	*min.*	*sec.*
365	250	23	59	58
487	241	21	40	47
683	264	20	56	51
387	146	19	37	44
486	153	16	43	29
764	234	18	49	48

23. Find the amount of the following sums: £46 14s 8d, £96 18s 6d, £47 18s 9d, £37 19s 10d, and £13 12s 4d. *Ans.* £243 4*s* 1*d*.

24. In a contribution, A put in £7 14s 6d; B put in £1 8s 9d; C put in 12s 8d; D put in 6d 2qrs; E put in 17s; and F 12s 4d: how much did they all pay?
Ans. £11 5*s* 9*d* 2*qrs*.

25. If 7 men should each of them pay a sum of £14 7s 8d 2qrs, how much would they all pay?
Ans. £100 13*s* 11*d* 2*qrs*.

26. A man had three sons: John was 6 years 4 months old; George was 8 years 6 months and 12 days old; James was 18 years old. What was the age of all of them? *Ans.* 32 *yrs.* 10*mo.* 12 *days*.

27. Bought a quantity of goods at New York to the amount of £384 17s 8; paid for carting to the dock, 12s 8d; paid for freighting the same to Albany, £2 17s 8d; then paid for carting the same to Geneva, £7 1s 10; and my own expenses were £6 14s 9; how much do the goods stand me in at Geneva? *Ans.* £402 4*s* 7*d*.

28. If A should pay 15*s* 8*d*; B pay twice as much; C pay twice as much as B; D pay 7*s* 6*d*; and E pay as much as all the others; how much money would they all pay? *Ans.* £11 14*s* 4*d*.

29. If I have a silver tankard that weighs 3 pounds 7 ounces 16 pennyweights and 4 grains, and a dozen silver table-spoons, weighing 1 pound and 12 grains, a sugar bowl that weighs 9 ounces and 10 pennyweights, and six tea-spoons weighing 17 pennyweights each; how heavy do they all weigh? *Ans.* 5 *lbs.* 10 *oz.* 8 *dwt.* 16 *grs.*

30. Suppose I have five barrels of potash, whose weight is as follows: the first weighs 3 cwt. 1 qr. and 12 lbs.; the second, 2 cwt. 3 qrs. and 26 lbs.; the third, 3 cwt. 3 qrs. and 6 lbs.; the fourth, 3 cwt. and 17 lbs.; the fifth, not being well packed, would not weigh more than 2 cwt. 24 lbs.: what is the weight of the whole?

Ans. 15 *cwt.* 2 *qrs.* 1 *lb.*

COMPOUND SUBTRACTION

Teacheth to find the inequality between numbers of divers denominations.

Rule. Having arranged the numbers so that the smaller may stand under the greater, subtract each number in the lower line from that which stands above it, and write down the remainders. When any of the lower denominations are greater than the upper, increase the upper number by as many as make one of the next higher denomination, from which take the figure in the lower line, and set down the remainder, carry one to the next number in the lower line, and subtract as before.

EXAMPLES.

FEDERAL MONEY.

(1.)

$	*cts.*	*m.*
687	45	6
367	37	4

(2.)

$	*cts.*	*m.*
99	48	9
86	56	7

STERLING MONEY.

(3.)

£	s.	d.	qr.
100	18	10	3
60	14	6	1

(4.)

£	s.	d.	qr.
4	6	4	2
3	9	9	3

TROY WEIGHT.

(5.)

lb.	oz.	dwt.	gr.
47	10	2	16
8	9	8	6

(6.)

lb.	oz.	dwt.	gr.
100	9	15	16
99	7	18	7

AVOIRDUPOIS WEIGHT.

(7.)

ton	cwt.	qr.	lb.	oz.	dr.
70	8	3	24	4	12
62	16	2	26	15	7

(8.)

cwt.	qr.	lb.
95	3	6
54	2	26

APOTHECARIES WEIGHT.

(9.)

lb.	oz.	dr.	sc.	gr.
67	8	6	2	16
43	7	7	2	9

(10.)

lb.	oz.	dr.	sc.	gr.
9	6	5	2	5
4	3	3	2	4

CLOTH MEASURE.

(11.)

yd.	qr.	na.
65	3	3
48	2	3

(12.)

E.Fl.	qr.	na.
189	1	3
160	2	2

(13.)

E.E.	qr.	na.
60	3	3
43	2	2

WINE MEASURE.

(14.)

tun.	hhd.	gal.	qt.	pt.
996	3	34	3	1
645	2	60	2	1

(15.)

hhd.	gal.	qt.	pt.
77	62	3	1
69	24	2	0

ALE AND BEER MEASURE.

(16.)

hhd.	gal.	qt.	pt.
89	46	2	1
67	55	3	1

(17.)

hhd.	gal.	qt.	pt.
675	60	2	1
586	50	3	0

DRY MEASURE.

(18.)

qr.	bu.	gal.	qt.
38	4	3	3
36	5	5	2

(19.)

chal.	bu.	gal.	qt.
637	31	4	2
387	35	5	2

LONG MEASURE.

(20.)

deg.	m.	fur.	p.	ft.	in.	b.c.
867	63	6	27	8	9	1
643	60	4	8	11	11	2

(21.)

m.	fur.	p.	ft.
49	6	13	11
37	7	15	8

LAND MEASURE.

(22.)

acr.	roo.	per.
675	2	11
484	3	15

(23.)

acr.	roo.	per.
75	1	3
69	3	8

TIME.

(24.)

yrs.	da.	hr.	m.	sec.
437	116	18	44	36
311	100	9	59	45

(25.)

yrs.	da.	hr.	m.	sec.
67	360	21	50	50
18	364	23	46	56

SOLID, OR CUBIC MEASURE.

(26.)

cord	ft.	in.
45	118	136
60	87	96

(27.)

ton	ft.	in.
24	37	184
37	24	1712

28. Borrowed £50 10s: paid again at one time £17 11s 6d; and at another time £9 4s 8d; at another time £17 9s 6d; and at another time 19s 6d 2 qrs. How much remains unpaid? *Ans.* £15 4*s* 9*d* 2 *qrs.*

29. Borrowed £100, and paid in part as follows, viz., at one time £21 11s 6d; at another time £19 17s 4d 2 qrs; at another time 10 dollars, at 6 shillings each; and at another time 2 English guineas, at 28 shillings each, and 2 pistareens, at 14d 2 qrs each; how much remains due, or unpaid? *Ans.* £52 12*s* 8*d* 2 *qrs.*

30. A, B, and C, drew their prize-money as follows, viz., A had £75 15s 4d; B had three times as much as A lacking 15s 6d; and C had as much as A and B both; how much had C? *Ans.* £302 5*s* 10*d.*

31. I lent John Paywell 1000 dollars, and afterward lent him 26 dollars and 45 cents more. He has paid me at one time 361 dollars 40 cents, and at another time 416 dollars 9 cents, besides a note which he gave me on Peter Trusty for 143 dollars 90 cents; how stands the balance between us? *Ans.* $105,06 *cts. my due.*

32. Paid A B in full for E F's bill on me for £105 10s, viz.; I gave him Paul Jones' note for £15 14s 9d; John Cook's note for £30 0s 6d; an order on Sam Patch for £39 11s; the rest I make up in cash. I wish to know what sum will make up the deficiency?

Ans. £20 3*s* 9*d.*

COMPOUND MULTIPLICATION

Is the multiplying of numbers of different denominations by a simple figure or figures, whose product shall be equal to a proposed number or numbers.

Rule.- Write the multiplier under the lowest denomination of the multiplicand; multiply every number of the multiplicand by the multiplier, and bring the several products as they occur to the next higher denomination; write down the remainders, and carry the integers to the next product.

EXAMPLES.

STERLING MONEY.

(1.)

£	s.	d.
36	14	8
		2

(2.)

£	s.	d.
24	16	7
		3

(3.)

£	s.	d.	qr.
675	4	6	2
			8

(4.)

£	s.	d.	qr.
76	8	3	3
			12

TROY WEIGHT.

(5.)

lb.	oz.	dwt.	gr.
76	10	14	23
			9

(6.)

lb.	oz.	dwt.	gr.
4	6	8	4
			11

AVOIRDUPOIS WEIGHT.

(7.)

ton	cwt.	qr.	lb.	oz.	dr.
647	7	1	16	10	12
					5

(8.)

lb.	oz.	dr.
96	11	12
		6

APOTHECARIES WEIGHT.

(9.)

lb.	oz.	dr.	sc.	gr.
44	4	4	2	16
				7

(10.)

lb.	oz.	dr.	sc.	gr.
16	8	3	1	14
				12

CLOTH MEASURE.

(11.)

yd.	qr.	na.
8	3	1
		4

(12.)

E. E.	qr.	na.
64	2	2
		6

(13.)

E. Fr.	qr.	na.
18	1	1
		8

WINE MEASURE.

(14.)

tun	*hhd.*	*gal.*	*qt.*	*pt.*
3764	1	60	3	1
				11

(15.)

hhd.	*gal.*	*qt.*	*pt.*
900	45	1	1
			10

ALE AND BEER MEASURE.

(16.)

hhd.	*gal.*	*qt.*	*pt.*
15	18	3	1
			16

(17.)

hhd.	*gal.*	*qt.*	*pt.*
227	40	3	0
			14

DRY MEASURE.

(18.)

qt.	*bu.*	*gal.*	*qt.*
47	5	3	2
			18

(19.)

chal.	*bu.*	*gal.*	*qt.*
88	31	4	1
			6

LONG MEASURE.

(20.)

deg.	*m.*	*fur.*	*p.*	*ft.*	*in.*	*b. c.*
64	49	4	27	16	11	1
						19

(21.)

m.	*fur.*	*p.*	*ft.*
69	4	15	12
			20

LAND MEASURE.

(22.)

acr.	*roo.*	*per.*
1000	3	14
		14

(23.)

acr.	*roo.*	*per.*
70	1	2
		15

(24.)

acr.	*roo.*	*per.*
55	2	8
		16

SOLID, OR CUBIC MEASURE.

(25.)

cord	*ft.*	*in.*
379	114	8
		70

(26.)

ton	*ft.*	*in.*
666	83	1726
		60

TIME.

(27.)

yo.	*da.*	*hr.*	*m.*	*sec.*
63	118	11	40	61
				35

(28.)

yr.	*da.*	*hr.*	*m.*	*sec.*
91	361	5	5	15
				86

NOTE. When the multiplier is a composit number, and greater than 12, take any two such numbers as, when multiplied together, will exactly produce the given quantity, and multiply first by one of those figures, and that product by the other, and the last product will be the answer. When no two numbers, multiplied together, will exactly make the multiplier, you may multiply by any two whose product will come the nearest; then multiply the upper line by what remained; which, added to the last product, gives the answer.

BILL OF PARCELS.

Boston, June 15th,, 1839.

Mr. Peter Dow,

Bought of Geo. Smith & Co.

8	pairs worsted hose,	at 4s 6d,	$6 00
5	do. thread do.	" 3s 2d,	2 64
3	yds. kerseymere,	" 14s	7 00
6	do. muslin,	" 4s 2d,	4 16
2	do. tammy,	" 1s 8d,	0 56
4	shawls,	" 7s 6d,	5 00
64½	yds. nankins	" 2s	21 50
32	ells mode,	" 3s	16 00
28½	yds. calico,	" 2s 4d,	11 08
2	gross gilt coat buttons,	" 18s 6d,	6 17
3	pieces russel,	" 34s	17 00
2	do. muslin,	" 30s,	10 00
25	yds. Irish linen,	" 2s,	8 33
28½	do. stormount calico,	" 2s 6d,	11 88
28½	do. red do.	" 2s 2d,	10 29
1	piece durant,	" 56s,	9 33
2	pieces blue shalloon,	" 57s 6d,	19 17
50½	yds. dimity,	" 2s 6d,	21 04
3	pieces persian,	" 84s,	42 00

Amount at 6s to the dollar,	$229 15
8s - -	171 86
7s 6d -	183 32
4s 8d - -	294 6[illegible]

29. What is the weight of 7 hhds. of sugar, each weighing 9 cwt. 3 qrs. 12 lbs? *Ans.* 69 *cwt.*

30. What is the weight of 6 chests of tea, each weighing 3 cwt. 2 qrs. 9 lbs? *Ans.* 21 *cwt.* 1 *qr.* 26 *lbs.*

31. How much brandy in 9 casks, each containing 41 gals. 3 qts. 1 pt.? *Ans.* 376 *gals.* 3 *qts.* 1 *pt.*

32. In 35 pieces of cloth, each measuring 27 yds. 3 qrs., how many yards? *Ans.* 971 *yds.* 1 *qr.*

33. In 9 fields, each containing 14 acres 1 rood and 25 pr., how many acres? *Ans.* 129 *acrs.* 2 *roo.* 25 *pr.*

34. In 6 parcels of wood, each containing 5 cords and 96 feet, how many cords? *Ans.* 34 *cords* 64 *feet.*

35. A gentleman having 18 silver spoons, each weighing 2 oz. 15 dwt. 11 grs.; also 24 tea-spoons, each weighing 10 dwt. 14 grs.; and 2 silver tankards, each weighing 21 oz. 15 dwt. Pray, what is the weight of the whole? *Ans.* 8 *lbs.* 10 *oz.* 2 *dwt.* 6 *grs.*

COMPOUND DIVISION

TEACHETH to find how often one number is contained in another of different denominations.

Rule. Begin at the left hand, and divide each denomination by the divisor, setting down the quotients under their respective dividends. But if there be a remainder after dividing any of the denominations except the least, find how many of the next lower denomination it is equal to, and add it to the number, if any, which was in this denomination before, then divide the sum as usual, and so on, till the whole is finished.

The method of proof is the same as in Simple Division.

STERLING MONEY.

(1.)

£	s.	d.
2)64	18	6
32	9	3

(2.)

£	s.	d.	qr.
3)375	13	7	2
125	4	6	2

TROY WEIGHT.

(3.)

lb.	*oz.*	*dwt.*	*gr.*
8)44	8	12	4

(4.)

lb.	*oz.*	*dwt.*	*gr.*
7)75	3	16	19

AVOIRDUPOIS WEIGHT.

(5.)

ton	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*
9)48	16	1	14	13	12

(6.)

lb.	*oz.*	*dr.*
11)14	3	3

APOTHECARIES WEIGHT.

(7.)

lb.	*oz.*	*dr.*	*sc.*	*gr.*
12)337	4	5	1	14

(8.)

lb.	*oz.*	*dr.*	*sc.*	*gr.*
4)37	1	1	1	4

CLOTH MEASURE.

(9.)

yd.	*qr.*	*na.*
6)74	2	3

(10.)

E.E.	*qr.*	*na.*
7)88	1	1

(11.)

E.Fl.	*qr.*	*na.*
8)77	2	1

WINE MEASURE.

(12.)

tun	*hhd.*	*gal.*	*qt.*	*pt.*
10)99	2	56	3	1

(13.)

hhd.	*gal.*	*qt.*
9)777	44	1

ALE AND BEER MEASURE.

(14.)

hhd.	*gal.*	*qt.*	*pt.*
11)83	53	1	0

(15.)

hhd.	*gal.*	*qt.*	*pt.*
6)911	45	3	1

DRY MEASURE.

(16.)

bu.	*gal.*	*qt.*
7)34	5	3

(17.)

chal.	*bu.*	*gal.*	*qt.*
9)643	33	4	3

LONG MEASURE.

(18.)

deg.	*m.*	*fur.*	*p.*	*ft.*	*in.*	*b. c.*
3)47	49	6	27	8	10	2

(19.)

m.	*fur.*	*r.*
7)37	4	30

LAND MEASURE.

(20.)

acr.	*roo.*	*r.*
12)46	2	18

(21.)

acr.	*roo.*	*per.*
12)974	1	37

SOLID, OR CUBIC MEASURE.

(22.)

ton	*ft.*	*in.*
11)91	39	144

(23.)

ton	*ft.*	*in.*
11)684	17	1727

TIME.

(24.)

yr.	*da.*	*hr.*	*m.*	*sec.*
12)365	113	11	39	49

(25.)

yr.	*da.*	*hr.*	*m.*
9)4	1	1	1

NOTE. When the divisor is large, and not a composit number, you may divide by the whole divisor at once, after the manner of long division, thus:

(26.)

£ s. d.
37)46 1 11(£1
37
—
9
20
—
37)181(4*s*
148
—
33
12
—
37)407(11*d*
407
—

Ans. £1 4*s* 11*d*.

(27.)

lb. *oz.* *dwt.*
24)26 1 5(1*lb*
24
—
2
12
—
24)25(1*oz.*
24
—
1
20
—
24)25(1*dwt.*
24
—
1
24
—
24)24(1*gr.* *Ans.* 1lb. 1oz. 1dwt. 1gr.

28. Divide 4 gallons and 2 quarts of brandy equally among 144 soldiers. *Ans.* 1 *gill a piece.*

29. Bought 12 silver spoons, which together weighed 3 lb. 2 oz. 13 dwt. 12 gr., how much silver did each spoon contain? *Ans.* 3 *oz.* 4 *dwt.* 11 *grs.*

30. Bought 17 cwt. 3 qrs. 19 lbs. of sugar, and sold out one-third of it; how much remains unsold?

Ans. 11 *cwt.* 3 *qr.* 22 *lbs.*

31. From a piece of cloth containing 64 yards 2 nails, a tailor was ordered to make 9 soldiers' coats, which took one-third of the whole piece; how many yards did each coat contain? *Ans.* 2 *yds.* 1 *qr.* 2 *na.*

32. If a man spends £74 14s 6d a year, what is that per calendar month? *Ans.* £5 19*s.* 6½*d.*

33. The Prince of Wales' salary is £150,000 a year; what is that per day? *Ans.* £410 19*s* 2*d.*

34. A privateer takes a prize worth 12,465 dollars, of which the owner takes one-half, the officers one-fourth, and the remainder is equally divided among the sailors, who are 125 in number; how much is each sailor's part?

Ans. $24,93 *cts.*

DECIMAL FRACTIONS.

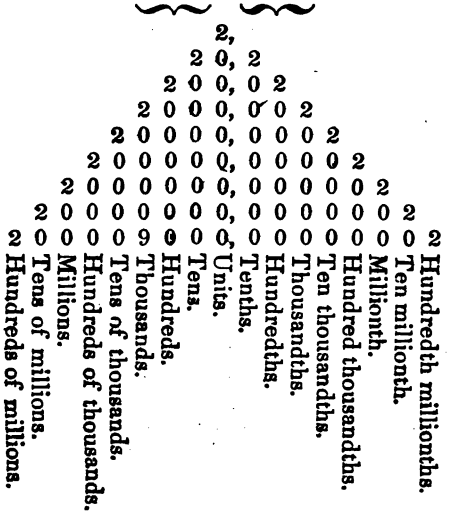
A DECIMAL FRACTION is that whose denominator is an unit, with as many ciphers annexed to it as the numerator has places, and is usually expressed by writing the numerator only, with a point before it, called the separatrix; thus, $\frac{5}{10}$ $\frac{25}{100}$ $\frac{125}{1000}$ are decimal fractions, and are expressed by ,5 ,25 ,125 respectively. The figures to the left hand of the separatrix are whole numbers; thus, 4,5 yards is 4 yards and 5 tenths, or one half of another yard.

Ciphers placed to the right hand of decimals make no alteration in their value; ,5 ,50 ,500, &c., are decimals of the same value, being each equal to $\frac{1}{2}$; but when placed to the left hand, the value of the fraction is decreased in a tenfold proportion; thus, 5, 05 ,005, &c., are 5 tenth parts, 5 hundredth parts, 5 thousandth parts, respectively.

The different value of figures will appear plainer by the following

TABLE.

Integers. *Decimals.*



From the above table it appears that as whole numbers increase in a tenfold proportion from units to the left hand, so decimals decrease in the same proportion to the right: and that in decimals, as in whole numbers, the place of a figure determines its relative value.

Example for writing Decimals.

Five tenths,	,5
Five hundredths,	,05
Five thousandth,	,005
Five hundred thousandths,	,0005
Fifty-three thousandths,	,053
Five and fifteen hundredths,	5,15

ADDITION OF DECIMALS.

Rule. Place the given numbers so that the decimal points may stand directly under each other; then add as

in whole numbers, and point off so many places for decimals to the right as are equal to the greatest number of the decimal places in any of the given numbers.

EXAMPLES.

(1.)	(2.)	(3.)
263,51	42,23	2,1
149,28	18,47	,5
293,53	9,3	26,17
184,59	52,384	,7
129,4	2,1	5,
1020,31	124,484	34,47

4. Required, the sum of twenty-nine and three-tenths, three hundred and seventy-four and nine millionths, ninety-seven and two hundred and fifty-three thousandths, three hundred and fifteen and four hundredths, twenty-seven, one hundred and four-tenths. *Ans.* 942,993009.

5. Required, the sum of ten dollars and twenty-nine cents, ninety-three cents and three mills, nine cents and six mills, and two dollars and eight mills.

Ans. $13,32 *cts.* 7 *m.*

SUBTRACTION OF DECIMALS.

Rule. Place the given numbers so that the decimal points may stand directly under each other, and point off the decimal places, as in Addition.

EXAMPLES.

	(1.)	(2.)	(3.)
From	219,42	87,26	57,
Take	184,38	19,4	9,375
	35,04	67,86	47,625

4. From two thousand and sixteen hundredths, take one thousand and four and four millionths.

Ans. 996,59996.

5. From twenty-four thousand nine hundred and nine and one-tenth, take fourteen thousand and twenty-nine thousandths. *Ans.* 10909,071.

6. Take eighty-five and seven hundred and thirty-seven thousandths from one hundred. *Ans.* 14,263.

7. From five hundred and thirty-one dollars two cents, take one hundred and seventeen dollars three cents and four mills. *Ans.* $413,98 *cts.* 6 *m.*

8. From ten dollars and eight cents, take one dollar and three mills. *Ans.* $9,07 *cts.* 1 *m.*

MULTIPLICATION OF DECIMALS.

MULTIPLY exactly as in whole numbers, and from the product cut off as many figures for decimals to the right hand as there are decimals in both factors; but if the product should not have so many, supply the defect by prefixing ciphers.

EXAMPLES.

(1.)	(2.)
Multiply 36,5	29,831
by 7,27	,952
2555	59662
730	149155
2555	268479
265,355	28,399112

(3.)	(4.)	(5.)
Multiply ,285	,285	,29
by ,8	,003	,1
,2280	,000855	,029

Note. To multiply decimal fractions by 10, 100, 1000, &c., is only to remove the separatrix so many places towards the right as there are ciphers.

Thus: 7,362937 { 10, 73,62937 ; 100, 736,2937 ; 1000, 7362,937 ; 10000, 73629,37 }

6. Multiply two thousand and four and two-tenths by twenty-seven. *Ans.* 54113,4.

DIVISION OF DECIMALS.

Rule. Divide as in whole numbers, and from the right hand of the quotient point off as many places for decimals as the decimal places in the dividend exceed those of the divisor. If the places of the quotient are not so many as the rule requires, supply the defect by prefixing ciphers. If at any time there be a remainder, or the decimal places in the diyisor are more than those in the dividend, ciphers may be annexed to the dividend, and the quotient carried to any degree of exactness.

EXAMPLES.

(1.)	(2.)
92),863972(,009391	,853)89,000(104,327
828	853
359	3700
276	3412
837	2880
828	2559
92	3210
92	2559
	6510
	5971
	539

3. Divide ,803 by ,22 *Ans.* 3,65
4. Divide 8,03 by 2,2 365
5. Divide ,803 by 22 ,0365
6. Divide 80,3 by ,22 36,5
7. Divide 80,3 by 2,2 3,65
8. Divide 222 by 365 ,60821+

To reduce quantities of several denominations to a decimal.

Rule. Place the several denominations above each other, *letting* the highest denomination stand at the bottom; then

divide each denomination (beginning at the top) by its value in the next denomination, the last quotient will give the decimal required.

EXAMPLES.

1. Reduce 12s 6d 3qrs to the decimal of a pound.

4	3,
12	6,75
20	12,5625
	,628125

2. Reduce 15s 9d 3qrs to the decimal of a pound.

Ans. ,790625.

3. Reduce 9d 3qrs to the decimal of a shilling.

Ans. ,8125.

Note. When the shillings are even, half the number, with a point prefixed, is their decimal expression; but if the number be odd, annex a cipher to the shilling, and then, by halving them, you will have their decimal expression.

REDUCTION

TEACHETH to change numbers from one denomination to another, without losing their value.

When numbers of a higher denomination are to be reduced to a lower, it is called Reduction Descending, and it is performed by Multiplication. When numbers of a lower denomination are to be brought to a higher denomination, it is called Reduction Ascending, and it is performed by Division.

REDUCTION DESCENDING.

Rule. Multiply the highest denomination by as many of the next less as make one of the greater, adding to the product the parts of the same name, and so on to the last.

EXAMPLES.

1. In £987 14s 6d 3 qrs., how many farthings?

987 14 6 3
20

19754 shillings.
12

237054 pence.
4

948219 farthings.

2. In 11 oz. 13 dwt. 13 grs., how many grains?

Ans. 5605 *grs.*

3. In 13 cwt. 3 qrs. 21 lbs., how many pounds?

Ans. 1561 *lbs.*

4. In 57 years, how many hours, allowing each year to be 365 days 6 hours? *Ans.* 499662 *hours.*

REDUCTION ASCENDING.

Rule. Divide the given number by as many of that denomination as make one of the next higher, and so on to the denomination required, and the last quotient, with the several remainders, if any, will be the answer.

EXAMPLES.

1. In 46788 farthings, how many pence, shillings, and pounds?

4)46788

12)11697

2,0)97,4---9

48--14--9

Ans. £48 14*s* 9*d.*

1. In 900 farthings, how many pounds?

Ans. £0 18*s* 9d.

3. In 243648 farthings, how many dollars, at 6 shillings each? *Ans.* 846 *dollars.*

4. *Reduce* 13776 pence to guineas, at 28s per guinea.

Ans. 41 guineas.

5. In 62304 farthings, how many pistoles, at 22s each?
Ans. 59 *pistoles.*

6. In 24396 pence, how many shillings, pounds, and pistoles? *Ans.* 2033*s*, £101 13*s*, *and* 92 *pistoles and* 9*s over.*

Questions promiscuously placed.

1. Suppose A and B were to travel from Vergennes, in the State of Vermont, to Geneva, in the State of New York, the distance being 300 miles; A steps 2 feet 6 inches each step, and B but 2 feet 4 inches; how many more steps must B take to perform his journey than A?
Ans. 45257.

2. It is supposed the wars of Bonaparte, in 20 years, caused the death of 2,000,000 of persons; how many was this per hour, allowing the year to contain 365 days 6 hours? *Ans.* $11\frac{71480}{175320}$.

3. A goldsmith having 15 ingots of silver, each weighing 2 lbs. 7 oz. 3 dwt., which he wished to make into bowls of 2 lbs. 8 oz., tankards of 1 lb. 10 oz. salts of 11 oz., and spoons of 1 oz. 15 dwt., and of each an equal number; how many will there be of each sort? *Ans.* 7.

4. If sound, uninterrupted, moves 1142 feet in one second, how long would it be in passing from the sun to the earth, the distance being estimated at 95,000,000 of miles? *Ans.* 13 *yrs.* 338 *d.* 16*h.* 10 *m.* 22 *sec.* $\frac{76}{1142}$.

5. Admit a ship's cargo from London to be 250 pipes, 130 hhds., and 150 half hhds., how many gallons in all, allowing every pint to be a pound, and what is the ship's burden? *Ans.* 44415 *gals., and* 158 *tons,* 12 *cwt.* 2 *qrs.*

RULES OF PROPORTION.

HAVING introduced the fundamental principles of Arithmetic, we come now to the rules of proportion. Under this head may be classed the following, viz., Multiplication and division of fractions, reduction of fractions, reduction of currencies, interest, banking, commission insurance, ratio, simple and compound proportion, simple and compound proportion in fractions, conjoined proportion, discount, profit and loss, barter, partnership, commercial exchange, tare and tret, equation of payments, mensuration or practical geometry, &c. &c., and in fact

almost every thing where multiplication and division are concerned. It is very important, not only to know how to solve propositions under the various rules, but also how they may be solved most expeditiously. The principle of cancelling is doubtless the greatest desideratum for facilitating arithmetical problems that has ever been introduced into the science of mathematics. The object of which is, to acquaint the scholar with a principle by which peculiar expedition is attained in the solution of such sums as involve in their operation both multiplication and division. This principle is founded on the following facts: First, The value of any quotient depends on the ratio, or relative size of the numbers divided; that is, if the dividend be five times as large as the divisor, the value of the quotient is five, and if it be eight times as large, the value is 8, &c. Second, If two or more numbers are to be multiplied together, and their product divided by any other number, the true result is obtained by first dividing one of these numbers, by the dividing number, and then multiplying the quotient by the remaining number or numbers. Thus, if it be required to multiply 8 by 4 and to divide the product by 2, first divide 8 by 2 and multiply the quotient by 4, thus, $8 \div 2 = 4$, and $4 + 4 = 16$. The advantage of this process will be more obvious if we take large numbers. Suppose we wish to multiply 1728 by 16, and to divide the product by 144, the usual process would be thus:

```
  1728
    16
  ----
 10368
 1728
 ----
144)27648(192
 144
 ---
 1324
 1296
 ----
  288
  288
  ---
  000
```

By first dividing the operation is much abbreviated, thus:

```
144)1728(12
  1728(16
  ----  ---
  0000  192
```

By the usual method, 46 figures are required, by the other only 22. There is still another advantage. The scholar can see at a glance that 144 is contained in 1728 twelve times, and that 12 times 16 is 192; so that an operation, which is long and protracted, is often reduced nearly or quite to a mental operation. Third, When any large number is to be divided by the product of two or more smaller numbers, it may be divided by each number separately. This needs no explanation, it is the same as dividing by the component parts of any number, instead of the number itself. Fourth, When the operation is of such a nature as to require the product of several numbers to be divided by the product of several other numbers, these numbers may be divided before multiplication, and their quotients used, instead of the numbers themselves. For illustration, suppose the product of 36 and 42 is to be divided by the product of 6 and 7, the usual mode of operation would be as follows, viz:

```
  42          6
  36          7
  --          -
 252         42 Divisor.
126
---
1512 Dividend.

42)1512(36  The required
  126       quotient.
  ---
  252
  252
  ---
    000
```

But by the preceding fourth principle, $36 \div 6 = 6$, and $42 \div 7 = 6$, and $6 + 6 = 36$. Ans. In this example the divisors are, as it were, expunged or lost, since they divide without remainder.

But for further illustration, suppose it be required to multiply the numbers 72, 40, 84 and 36 together, and to divide the product successively by 12, 8, 144 and 7. It is desirable to arrange these numbers so that they may be *conveniently* compared with each other. We will adopt

the following mode: We will place the numbers whose product is to form a dividend, on the right hand side of a perpendicular line, and those whose product is to form a divisor, on the left hand side, thus:

144	72
5	40
7	84
12	36

Now, by the fourth and last principle laid down, I can divide 144 in the divisor and 72 in the dividend by 72, without a remainder, and obtain 2 in the divisor and 1 in the dividend, thus:

2	1
5	40
7	84
12	36

I can also divide 40 in the dividend and 5 in the divisor by 5, and obtain 8 in the dividend and 1 in the divisor, thus:

2	1
1	8
7	84
12	36

Again, I can divide 84 in the dividend and 7 in the divisor by 7, and obtain 12 in the dividend and 1 in the divisor, thus:

2	1
1	8
1	12
12	36

Again, I can divide 36 in the dividend and 12 in the divisor by 12, and obtain 3 in the dividend and 1 in the divisor, thus:

2	1
1	8
1	12
1	3

Again, I can divide 8 or 12 in the dividend and 2 in the

divisor by 2, and obtain 4 or 6 in the dividend and 1 in the divisor, thus :

1	1
1	4
1	12
1	3

It is now evident that the division can be carried no farther without remainder. The next step, therefore, is to divide the product of the numbers remaining on the right hand side of the line, by the product of those on the left. The product of those on the right is 4+12+3=144 ,and of those on the left 1+1+1+1=1, therefore 144÷1=144, the number required. The same result would have been obtained by multiplying the numbers together on the right hand side of the line, and dividing their product by the product of those on the left hand side, previous to cancelling. In the above example, as the numbers have been cancelled they have been omitted, and a new statement made. This is by no means necessary. One statement is sufficient. It will be noticed that in every instance division is effected without a remainder. Such must always be the case.

The following rules will be found a competent guide for the learner in all operations of cancelling:

GENERAL RULES.

Rule 1st. Draw a perpendicular line; observe this line represents the sign of equality. On the right hand side of this line, place dividends only; on the left hand side place divisors only. Having placed dividends on the right and divisors on the left, as above directed,

2d. Notice whether there are ciphers both on the right and left of the line; if so, erase an equal number from each side.

3d. Notice whether the same number stands both on the right and left of the line; if so, erase them both.

4th. Notice, again, if any number on either side of the line will divide any number on the opposite side, without a *remainder*; if so, divide and erase the two numbers,

retaining the quotient figure only on the side of the larger number.

5th. See if any two numbers, one on each side, can be divided by any assumed number without a remainder; if so, divide them by that number, and retain only their quotients. Proceed in the same manner, as far as practicable, then,

6th. Multiply all the numbers remaining on the right hand side of the line for a dividend, and those remaining on the left for a divisor.

7th. Divide, and the quotient is the answer.

Note. If only one number remain, on either side of the line, that number is the dividend or divisor, according as it stands on the right or left of the line. The figure 1 is not regarded in the operation, because it avails nothing either to multiply or divide by.

VULGAR FRACTIONS.

Fractions or broken numbers, are expressions for any assignable part of an unit, and are represented by two numbers, placed one above the other, with a horizontal line drawn between them. The number above the horizontal line is called the numerator, and that below the line the denominator. The denominator shows how many parts the integer is divided into, and the numerator shows how many of those parts are meant by the fraction.

Fractions are either proper, improper, compound, or mixed.

1st. A proper fraction is when the numerator is less than the denominator, as $\frac{1}{3}$, $\frac{4}{5}$, $\frac{6}{7}$, $\frac{10}{12}$, $\frac{144}{1728}$, $\frac{96845973}{108753864}$.

2. An improper fraction is when the numerator is either equal to or greater than the denominator, as $\frac{7}{7}$, $\frac{12}{9}$, $\frac{5}{1}$, $\frac{1728}{144}$.

3. A compound fraction is a fraction of fractions, and known by the word of, as $\frac{3}{4}$ of $\frac{5}{8}$ of $\frac{6}{7}$ of $\frac{9}{15}$ of $\frac{6}{9}$ of $\frac{12}{8}$ of $\frac{8}{1}$ of $\frac{12}{100}$.

4. A mixed number or fraction is composed of a whole number and a fraction, as $8\frac{3}{4}$, $124\frac{4}{7}$, $1728\frac{5}{8}$, $9999999\frac{9}{10}$. Mixed numbers may be reduced to improper fractions, by multiplying the whole number by the denominator of the *fraction,* and to the product add the numerator for a new *numerator,* and place it over the denominator.

ADDITION AND SUBTRACTION OF FRACTIONS.

Addition and subtraction of fractions are easily performed, if the fractions have common denominators. Examples: $\frac{1}{5}$, $\frac{2}{5}$, $\frac{3}{5}$, $\frac{4}{5}$, added together, equal $\frac{10}{5}$; here we merely add the numerators, and place their common denominator under the sum of the numerators for the answer. Again, add $\frac{1}{9}$, $\frac{4}{9}$, $\frac{7}{9}$, $\frac{5}{9}$, $\frac{8}{9}$, together $=\frac{25}{9}=2\frac{7}{9}$; adding the numerators, we have 25, placing the common denominator 9 under 25, we have the improper fraction $\frac{25}{9}$, or 2 whole numbers or integers, and $\frac{7}{9}$, making the mixed fraction $2\frac{7}{9}$.

To add and subtract fractions not having a common denominator, bring the different denominators to a common multiple, or the least common denominator, and raise the different numerators by the common denominator in the same proportion, after which add as above.

To bring different fractions to a common denominator, the largest denominator is retained, but all other denominators which, according to the properties of figures and numbers, can be resolved into any common factor contained in the largest denominator or any other denominator which is retained, are cancelled or thrown out of the question, after which multiply the remaining denominators or figures or numbers to a continued product, for the least common denominator.

Example. Find the least common denominator or multiple in the following series of denominators, from 2 to 10 inclusive, viz., 2, 3, 4, 5, 6, 7, 8, 9, 10; 10 being the largest denominator, is retained; 9 has no factor in common with 10, therefore 9 is retained: 8 has a relation or factor in common with 10, viz., 2, which cancelled into 8 leaves 4; therefore 4 is set down: 7 has no relation or factor in common with 10, 9, or 4; therefore 7 is retained: 6 has two factors, 2 and 3; the two is contained or cancelled in 10, and the 3 in 9; therefore 6 is left out: 5 is contained or cancelled in 10, therefore 5 is left out: 4 is contained or cancelled in 4, therefore 4 is left out: 3 is contained or cancelled in 9, therefore 3 is left out: 2 is contained or cancelled in 4 or 10, therefore 2 is left out.

Now, the numbers retained or remaining, viz., 10, 9, 4,

7, multiplied to a continued product, form the least common denominator of the above numbers, viz., 2520, by which raise the numerators in the same proportion; that is, by dividing the common multiple by each denominator, and multiplying the quotient by the numerator of the respective denominators; and this done, then add as previously.

EXAMPLE.

Add $\frac{9}{10}$, $\frac{5}{8}$, $\frac{6}{7}$, $\frac{2}{7}$, $\frac{8}{21}$.

—21	21	840 ÷ 10 =	84
—10	10	840 ÷ 8 =	105
— 8	4	840 ÷ 7 =	120
— 7	—	840 ÷ 7 =	120
— 7	840 Common denom.	840 ÷ 21 =	40
			2351

$2351 \div 840 = 2\frac{671}{840}$ Answer.

But to return to our principle of cancelling again. Suppose it be required to divide the product of 144, 77, 39, 24 and 96 by the product of 9, 16, 11, 13, 3, 6 and 7.

The statement to the above example, and the following, will be solved without repetition, that the learner may obtain accurate views relative to the mode of solution here presented.

Statement to the above example:

—9	144—
—16	77—
—11	39—
—13	24— 4
—3	96
—6	
—7	
	384

The numbers marked are cancelled, those remaining unmarked are 4 and 96, being multiplied together give the answer, 384. The result would have been the same had the right hand numbers been multiplied continually together, and divided by the continued product of the left hand figures and numbers.

Divide the product of 99, 49, 15, 20, 32, 13, 16 by the product of 77, 10, 16, 49, 39 and 12.

7	—77	99— 9— 3—
	—10	49
	—16	15
	—49	2 0—
—3	—59	32— 8
—4	—12	13—
		16—

7 | 240=34$\frac{2}{7}$ Answer.

In the solution of the last example, we first observe we have two 49s, one on each side of the line; these we cancel; also two 16s, these we strike out also; we have also two ciphers, these we cancel also; now, 77 and 99 have a common factor of 11, we cancel them both and substitute their quotients; 13 is also contained in 39, 3 times, we cancel both numbers, and place the 3 on the side of the greater number; this 3 is also contained in the 9 on the right hand side of the line 3 times; these we cancel, and place the 3 on the side of the greater; then this 3 is contained in 12 on the left 4 times, cancel the 3 and 12, and place the 4 on the side of the greater number; now, 4 is also contained in 32 on the right 8 times, these we also cancel and place the 8 on the side of the greater number. Now, it will be observed that we can cancel no farther, since there are no two numbers that will divide without a remainder: we have remaining on the right 15, 2 and 8, whose continued product is 240; this being divided by the remaining number on the left, viz., 7, gives the quotient 34$\frac{2}{7}$, the answer required.

Again: Suppose it is required to multiply 8001 by 735, this product to be divided by 7, this quotient to be multiplied by 33 times 51, this to be divided by 11 times 2667, this quotient again to be multiplied by 84 times 50, and finally to be divided by 34 times 81 for the answer. To perform the operation in the usual way it would require the following operations:

To multiply 8001
by 735

40005
24003
56007

2d. To be divided by 7)5880735(840105
33 1683
51
2520315
33 6720840
165 5040630
1683 840105

11+2667=29337)1413896715(48195
117348

240416
234696

57207
29337

278701
264633

146685
146685

And to multiply 48195 by 84+50=4200
4200

9639000
192780

To divide by) 202419000(73500
34+81=2754) 19278

9639
8262

13770
13770——00

But according to our simplified system we would proceed thus:

—7	8001— 3—
—11	735
—2667	33— 3—
—2 —34	51— 17—
—3 —9 —81	84— 12— 4— 2
	50
	73500 Result.

By the usual process it requires 235 figures.
Our simplified process 42
Difference 193

MULTIPLICATION OF FRACTIONS.

Rule. Place the numerators, both of the multiplicand and multiplier, on the right hand side of the perpendicular line, and the denominators on the opposite side.

Note. The reason for thus placing the numerators on the right, and the denominators on the left, is, that numerators are dividends, and denominators are divisors.

EXAMPLE.

Multiply $\frac{3}{7}$ of $\frac{7}{9}$ of $\frac{4}{5}$ of $\frac{10}{12}$ by $\frac{5}{7}$ of $\frac{6}{7}$ of $\frac{49}{60}$.

—7	3—
9	7—
—5	4—
—12	10—
—7	5—
—7	6—
—60	49—

9 — 1 = $\frac{1}{9}$ Answer.

27. Required the cost in dollars and cents of $\frac{2}{5}$ of $\frac{9}{10}$ of $\frac{9}{11}$ of $\frac{12}{13}$ of $\frac{10}{11}$ of $\frac{13}{15}$ of $3\frac{3}{4}$ of $\frac{1}{2}$ of $\frac{5}{9}$ of $\frac{2}{3}$ of $\frac{8}{11}$ of $\frac{3}{10}$ of $\frac{13}{16}$ of $\frac{4}{5}$ of a yard of pilot cloth, at $\frac{1}{3}$ of $\frac{5}{6}$ of $\frac{3}{4}$ of $\frac{9}{5}$ of $3\frac{1}{2}$ of $\frac{1}{5}$ of $\frac{2}{5}$ of $3\frac{3}{4}$ of $\frac{3}{10}$ of a dollar per yard. Ans. $ 0.00.166+.

Multiply $\frac{4}{5}$ of $\frac{5}{8}$ of $\frac{6}{7}$ of $\frac{7}{9}$ of 18 by $\frac{1}{2}$ of $\frac{7}{10}$ of $\frac{5}{7}$ of $\frac{3}{12}$ of 40.

—5	4—
—2 —8	5—
—7	6— 3
—9	7—
	18—
—2	1
—10	7—
—7	5
—12	3—
	40—
	15 Answer.

Multiply $\frac{1}{4}$ of $\frac{4}{5}$ of $\frac{6}{7}$ of $\frac{5}{8}$ of $\frac{7}{12}$ of $4\frac{4}{5}$ by $\frac{4}{10}$ of $\frac{20}{100}$ of 1000.

—4	1
—5	4—
—7	6
—8	5—
—12	7—
—5	24— 2—
—10	4
—100	20— 4—
	1000—
	24 Answer.

Multiply $3\frac{1}{3}$ of $\frac{20}{25}$ of $4\frac{4}{5}$ of 15 by $7\frac{3}{10}$ of $\frac{8}{24}$ of $\frac{6}{7}$ of $\frac{5}{365}$.

	—3	10—
5	—25	20— 4
	—5	24—
		15—
	—10	73—
	—24	8
	7	6
	—365	5—
35		192=5$\frac{11}{35}$ Answer.

1. Multiply $\frac{1}{2}$ by $\frac{1}{4}$. Ans. $\frac{1}{8}$.
2. " $\frac{1}{4}$ by $\frac{1}{2}$. Ans. $\frac{1}{8}$.
3. " $\frac{1}{3}$ of $\frac{3}{4}$ by $\frac{4}{9}$. Ans. $\frac{1}{9}$.
4. " $\frac{4}{9}$ by $\frac{1}{3}$ of $\frac{3}{4}$. Ans. $\frac{1}{9}$.
5. " $\frac{1}{3}$ of $\frac{2}{5}$ of $\frac{3}{4}$ by $\frac{1}{2}$ of $\frac{5}{6}$. Ans. $\frac{1}{24}$.
6. " $\frac{7}{8}$ of $\frac{9}{10}$ of $\frac{8}{9}$ of $\frac{5}{6}$ by $\frac{2}{3}$ of $\frac{6}{7}$. Ans. $\frac{1}{3}$.
7. " $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{4}{5}$ by $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{7}{8}$. Ans. $\frac{1}{8}$.
8. " $\frac{3}{4}$ of $\frac{7}{8}$ of $\frac{4}{7}$ by $\frac{1}{2}$ of 8. Ans. 2.
9. " $\frac{1}{2}$ of $\frac{9}{7}$ of $\frac{4}{5}$ of $\frac{7}{9}$ of $\frac{5}{4}$ by $\frac{2}{3}$ of 3. Ans. 1.
10. " $\frac{6}{7}$ of $\frac{4}{9}$ of $\frac{7}{4}$ of $\frac{1}{6}$ by $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{4}{5}$ of 10. Ans. $\frac{5}{9}$.
11. " $\frac{1}{2}$ of $\frac{4}{5}$ of $3\frac{1}{2}$ by $\frac{1}{7}$ of $\frac{2}{4}$ of 5. Ans. $\frac{1}{2}$.
12. " $\frac{3}{4}$ of $\frac{7}{8}$ of $\frac{4}{7}$ of $4\frac{1}{4}$ by $\frac{8}{17}$ of $3\frac{1}{3}$ of $\frac{4}{10}$. Ans. 1.
13. " $2\frac{1}{2}$ of $\frac{4}{5}$ of 8 by $3\frac{1}{4}$ of $\frac{7}{13}$ of $\frac{6}{7}$ of 4. Ans. 96.
14. " $\frac{3}{4}$ of $\frac{7}{8}$ of $\frac{4}{7}$ of $3\frac{1}{2}$ of $\frac{6}{7}$ by $4\frac{4}{5}$ of $\frac{7}{12}$. Ans. $3\frac{3}{20}$.
15. " $4\frac{4}{5}$ by $\frac{10}{12}$ of $\frac{1}{4}$. Ans. 1.
16. " $3\frac{1}{3}$ of $\frac{3}{5}$ by $\frac{1}{2}$ of $\frac{1}{4}$ of 4. Ans. 1.
17. " $5\frac{3}{5}$ of $\frac{6}{7}$ of $\frac{3}{4}$ by $\frac{1}{6}$ of 8. Ans. $4\frac{4}{5}$.
18. " $2\frac{6}{7}$ of $\frac{5}{10}$ of $\frac{2}{5}$ of $\frac{1}{2}$ by 4 and $\frac{4}{5}$ of $\frac{5}{8}$. Ans. $\frac{4}{7}$.
19. What will $2\frac{1}{3}$ lbs. of beef cost at $1\frac{1}{5}$ cents per lb.? Ans. $2\frac{4}{5}$ cts.
20. Required the cost of $3\frac{1}{3}$ lbs. of pork at $4\frac{4}{5}$ cents per lb. Ans. 16 cts.
21. Required the cost of $\frac{1}{4}$ of $\frac{4}{5}$ of $3\frac{1}{3}$ yards of tape at $2\frac{1}{4}$ cents per yard. Ans. $1\frac{1}{2}$ cts.
22. What will $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{4}{5}$ of $2\frac{1}{2}$ yards of ribbon cost at $\frac{2}{3}$ of $5\frac{3}{4}$ cents per yard? Ans. $4\frac{19}{24}$ cts.
24. A gentleman purchased $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{1}{5}$ of 7 yards of cassimere at $\frac{2}{9}$ of $3\frac{3}{5}$ dollars per yard. Required the cost. Ans. $\frac{4}{5}$ of a dollar.
25. Required the cost of $\frac{2}{3}$ of $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{6}{7}$ of $5\frac{1}{3}$ yards of satinet at $\frac{1}{2}$ of $\frac{3}{4}$ of $3\frac{2}{6}$ dollars per yard. Ans. $2\frac{1}{2}$ dollars.
26. Required the cost in dollars and cents of $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $4\frac{4}{5}$ yards of broadcloth at $\frac{5}{6}$ of $\frac{9}{10}$ of $\frac{3}{4}$ of $\frac{10}{13}$ of $\frac{7}{13}$ of $8\frac{2}{3}$ dollars yer yard. Ans. \$ 1 $31\frac{25}{100}$.

What will $\frac{4}{5}$ of $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{9}{12}$ of $\frac{8}{9}$ of $2\frac{3}{5}$ yards cloth *in dollars and cents*, at $\frac{1}{3}$ of $\frac{15}{16}$ of $\frac{4}{5}$ of $12\frac{1}{4}$ dollars per *yard?* Ans \$2 50.

28. A gentleman purchased $\frac{4}{5}$ of $\frac{3}{10}$ of $\frac{3}{4}$ of $\frac{8}{9}$ of $\frac{5}{6}$ of $4\frac{4}{5}$ of $\frac{8}{11}$ of $\frac{1}{2}$ of a yard of broadcloth at $\frac{3}{5}$ of $\frac{1}{2}$ of $\frac{1}{6}$ of 8 dollars per yard. Required the cost in dollars and cents.

Ans. $ 0 18 61+.

DIVISION OF FRACTIONS.

Rule. Place the numerators of the dividend, and the denominators of the divisor on the right hand side of the line, and the denominators of the dividend and the numerators of the divisor on the left hand side.

Note. This is called inverting the divisor.

EXAMPLES.

Divide $\frac{1}{2}$ of $\frac{7}{8}$ of $\frac{4}{7}$ of $\frac{12}{13}$ of $\frac{39}{48}$ by $\frac{4}{5}$ of $\frac{5}{12}$ of $\frac{9}{15}$ of $\frac{5}{9}$.

2	1
8	7—
—7	4—
—13	12—
—4 —48	39— 3
—4	5—
—5	12— 3
—9	15— 3
—5	9—
16	27=$1\frac{11}{16}$ Answer.

Divide $\frac{9}{10}$ of $\frac{15}{18}$ of $\frac{6}{7}$ of $4\frac{1}{5}$ by $\frac{4}{6}$ of $\frac{3}{8}$ of $\frac{5}{12}$ of $\frac{6}{20}$ of 100.

5 —10	9—
—2 —18	15— 3
—7	6— 3
—5	21—
—4	6—
—3	8— 4—
—5	12
—6	20—
25 —100	
125	108=$\frac{108}{125}$ Answer.

Divide $\frac{3}{5}$ of $\frac{5}{12}$ of $\frac{6}{8}$ of $\frac{5}{7}$ of $4\frac{4}{5}$ by $\frac{48}{50}$ of $\frac{1}{2}$ of $\frac{5}{8}$ of $\frac{4}{5}$ of 60.

—5	3—
4 —12	5—
—8	6—
7	5—
—5	24—
—2 —48	5,0—
1	2—
—5	8—
4	5—
—60	
112	5=$\frac{5}{112}$ Answer.

Divide $\frac{5}{18}$ of $\frac{6}{15}$ of $12\frac{3}{10}$ by $8\frac{1}{5}$ of $\frac{6}{30}$ of 10. Ans. $\frac{1}{12}$.

Divide $3\frac{1}{7}$ of $\frac{4}{11}$ of $\frac{7}{8}$ of 60 by $\frac{1}{2}$ of $\frac{5}{8}$ of $4\frac{4}{5}$ of $\frac{30}{96}$.

Ans. 128.

Divide $\frac{4}{7}$ of $\frac{7}{8}$ of $\frac{3}{100}$ of $\frac{200}{999}$ by $\frac{1}{3}$ of $\frac{3}{4}$ of $\frac{8}{4995}$. Ans. $\frac{3}{4}$.

Divide 100 by $\frac{4}{7}$ of $\frac{84}{88}$ of $\frac{6}{7}$ of $\frac{1}{3}$ of $\frac{49}{80}$ of 60. Ans. $17\frac{29}{63}$.

Divide $\frac{3}{7}$ of $\frac{7}{9}$ of 80 by $\frac{6}{8}$ of $\frac{9}{12}$ of $\frac{20}{25}$ of $\frac{8}{81}$ of 444.

Ans. $1\frac{3}{37}$.

18 men purchased $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{6}$ of $\frac{7}{6}$ of 24 yards of cloth and divided it equally. Required the share of each.

Ans. $\frac{7}{26}$ of a yard.

4 men bought $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $4\frac{4}{5}$ pounds of sugar, and divided it equally among them. Required the share of each man. Ans. $\frac{3}{10}$ of a lb.

12 men purchased $\frac{7}{8}$ of $\frac{5}{6}$ of $\frac{8}{9}$ of $\frac{4}{7}$ of $\frac{3}{5}$ of $\frac{6}{8}$ of $\frac{10}{12}$ of the ship Henry Clay. What part did each own? Ans. $\frac{5}{432}$.

MULTIPLICATION AND DIVISION OF FRACTIONS.

1. Divide $\frac{1}{4}$ of 19 by $\frac{2}{3}$ of $\frac{3}{4}$, and multiply it by $\frac{1}{3}$ of 6.

—4	1
	19
—2	3—
—3	4—
—3	1
	6— 2—
	19 Ans.

2. Divide $3\frac{1}{3}$ of $\frac{5}{6}$ by $\frac{1}{6}$ of 10. Multiply it by $\frac{5}{8}$ of 9. Divide the product by $\frac{7}{8}$ of 3. Multiply again by $2\frac{2}{5}$ of 7 for the answer.

—3	10—
—6	5—
1	6—
—10	
—8	5
	9— 3—
—7	8—
—3	
—5	12
	7—
	60 Ans.

3. Divide $\frac{2}{5}$ of $\frac{3}{4}$ by $\frac{4}{6}$ of 8. Multiply it by $\frac{8}{9}$ of $\frac{3}{7}$ of 12. Divide by $\frac{6}{8}$ of 12. Multiply by $\frac{3}{5}$ of 20. Divide by $\frac{5}{12}$ of 8. Multiply by $\frac{4}{6}$ of 30.

—3	2
—4	3—
—4	6
—8	
—3 —9	8—
7	3—
	12—
—6	8—
—12	3—
—5	20— 5—
—5	12— 2
—8	
—6	4—
	30— 6—
7	24=$3\frac{3}{7}$ *Ans.*

4. Divide $20\frac{2}{5}$ by $\frac{5}{7}\frac{1}{0}$. Multiply by $30\frac{2}{7}$. Divide by $5\frac{3}{5}$.

Multiply by $\frac{4}{5}$ of 7. Divide by $10\frac{3}{4}$. Multiply by $\frac{8}{20}$ of 100.

—5	102— 2
—51	—7 0
—7	212— 4—
3 —12 —48	9—
	4—
—9	7
—53	5—
—20	8
	100— 5
3	5600=1866$\frac{2}{3}$ *Ans.*

5. Divide $\frac{4}{5}$ of $\frac{3}{6}$ by $\frac{2}{7}$ of $\frac{3}{6}$. Multiply by $\frac{4}{7}$ of $\frac{8}{9}$ of 2. Divide by $\frac{4}{5}$ of $\frac{5}{6}$ of $9\frac{1}{2}$. Multiply by $\frac{38}{40}$ of 360.

—3 —9	4—
—8	3—
—2	7—
—3	6— 2
—7	4—
—9	8—
	2
—4	5—
—5	6— 2
—19	2—
—40	38— 2
	360— 4
	64 Ans.

6. Divide $\frac{24}{30}$ by $\frac{8}{18}$ of 12. Multiply by $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of 60. Divide by $\frac{3}{5}$ of 360.

—30	24--- 2---
—3	18---
—12	
—3	2---
—2 —4	3---
8	5---
	60--- 2---
3	9--- 3---
2 —4 —20 —360	
16	1=$\frac{1}{16}$. Ans.

7. Multiply $\frac{4}{5}$ of $\frac{5}{9}$ of 9. Divide by $\frac{2}{6}$ of 5. Multiply by $\frac{3}{3}$ of 6. Divide by $\frac{4}{5}$ of 15. Multiply by $\frac{5}{5}$ of 12. Divide by $\frac{3}{8}$ of 6. Multiply by $\frac{1\,8}{2\,4}$ of 4. Divide by $\frac{7}{8}$ of 12. Multiply by $\frac{1\,4}{2\,0}$ of 100.

	—5	4—
	—8	5—
		9—
	—9	6— 2
	—5	
	3	2
		6—
	—4	5—
—3	—15	
	—8	5—
		12—
	—3	8—
	—6	
—4	—24	18— 3—
		4—
	—7	8—
	—12	
	—20	14— 2—
		10 0—
	3	40=$13\frac{1}{3}$ *Ans.*

REDUCTION OF FRACTIONS.

Rule. Place the numerator of the given fraction on the right hand side of the perpendicular line, and its denominator on the left, then place also on the left, such numbers as are necessary to reduce the denomination given to that required, then proceed as before.

EXAMPLES.

Reduce $\frac{3}{4}$ of a farthing to the fraction of a shilling.

	4	3 far.
	far 4	1 penny
pence 4	—12	1 shilling
	64	1=$\frac{1}{64}$ part of a shill. Ans.

2. Reduce $\frac{4}{5}$ of a penny to the fraction of a pound.

5 | 4—
12 |
5 —20 |

300 | 1=$\frac{1}{300}$ *Ans.*

3. Reduce $\frac{7}{10}$ of a gallon to the fraction of a hogshead.

10 | 7—
9 —63 |

90 | 1=$\frac{1}{90}$ *Ans.*

4. Reduce $\frac{3}{5}$ of one ounce Troy to the fraction of a pound. *Ans.* $\frac{1}{320}$.

5. Reduce $\frac{81}{100}$ of a pound, avoirdupois, to the fraction of a cwt. *Ans.* $\frac{1}{1\,2\,3\,4}$.

6. Reduce $\frac{3}{8}$ of a nail to the fraction of an Ell French. *Ans.* $\frac{1}{64}$.

7. Reduce $\frac{5}{12}$ of a penny to the fraction of a pound. *Ans.* $\frac{1}{576}$.

8. Reduce $\frac{2}{12}$ of an hour to the fraction of a year. *Ans.* $\frac{1}{4380}$.

To reduce fractions of high denominations to equivalent fractions of low denominations.

Rule. Place the numerator of the given fraction on the right hand side of the perpendicular line, and the denominator on the left as before, then place on the right hand side of the line such numbers as are necessary to reduce the denomination given to that required, then proceed as before.

EXAMPLES.

9. Reduce $\frac{9}{16}$ of a shilling to the fraction of a farthing.

2 —8 —96 | 1
| 12—
| 4—

2 | 1=$\frac{1}{2}$ of a farthing. *Ans.*

10. Reduce $\frac{1}{360}$ of a pound to the fraction of a penny.

3 —360 | 1
| 2— 0
| 12—

3 | 2=$\frac{2}{3}$ *Ans.*

11. Reduce $\frac{1}{15}$ of a pound Troy to the fraction of an ounce.

5 —15 | 1
| 12— 4

5 | 4=$\frac{4}{5}$ *Ans.*

12. Reduce $\frac{1}{12}$ of a penny to the fraction of a farthing. *Ans.* $\frac{1}{3}$.

13. Reduce $\frac{1}{960000}$ of a mile to the fraction of a barley corn. *Ans.* $\frac{22}{500}$.

14. Reduce $\frac{3}{160}$ of an Ell English to the practice of a nail. *Ans.* $\frac{3}{8}$.

15. Reduce $\frac{1}{8490}$ of a year to the fraction of an hour. *Ans.* $\frac{12}{13}$.

REDUCTION OF CURRENCIES.

UNITED STATES MONEY.

The New England	6 shillings	equal	$1,00
Virginia	£3	"	10,00
Kentucky	3 shillings	"	50
Tennesse	18 pence	"	25
New York	8 shillings	equal	$1,00
	£2	"	5,00
North Carolina	4 shillings	"	50
	24 pence	"	25
Pennsylvania	7 shill. 6 pence	equal	$1,00
New Jersey	£3	"	8,00
Delaware	3 shillings	"	40
Maryland	9 pence	"	10
South Carolina	4 shill. 8 pence		$1,00
	£7		30,00
Georgia	7 shillings		1,50
	14 pence		25

To change pounds shillings and pence into dollars and cents.

Rule. Place the number of pounds given, on the right hand side of the perpendicular line, then see the proportion of United States' money, and place the number of pounds in that currency on the left hand side, and the equality of dollars on the right.

Prop. 1. Reduce £160, New York currency, to federal money. *Ans.* $400.

£--2 | 160—80
5$

400$ *Ans.*

2. Reduce £240, New Jersey currency, to federal money. *Ans.* $640.

3. Reduce £243, New Jersey currency, to federal money. $648.

4. Reduce £140, South Carolina currency, to federal money. $600.

5. Reduce £560, South Carolina currency, to federal money. $2400.

6. Reduce £27, New England currency, to federal money. $90.

7. Reduce £80, New York currency, to federal money. $200.

8. Reduce £45 12s. New Jersey currency, to federal money. $121 60.

9. Reduce £112, Georgia currency, to federal money. $480.

To change dollars and cents to pounds, shillings and pence.

Rule. Place the number of dollars given, on the right hand side of the perpendicular line, then see the proportion of United States money, and place the number of dollars in that currency on the left hand side, and the equality of pounds on the right.

Prop. 1. Reduce $648 to pounds, New Jersey currency.

Ans 243 pounds.

—8 | 648—81
| 3£

£243 *Ans.*

2. Reduce $450 to pounds, New York currency.

Ans. 180 pounds.

3. Reduce $360 to pounds, New England currency.

Ans. 108 pounds.

4. Reduce $240 to pounds, South Carolina currency.

Ans. 56 pounds.

5. Reduce $580 to pounds, Canada currency.

Ans. 145 pounds.

6. Reduce $642 875 to pounds, south Carolina currency. *Ans.* 150 pounds.

7. Reduce $141 to pounds, New England currency.

Ans. 42£ 6s.

8. Reduce $250 to pounds, Canada currency.

Ans. 62£ 10s.

9. Reduce $125 60 to pounds, New Jersey currency.

Ans. 47£ 2s.

10. Reduce $475 75 to pounds, New York currency.

Ans. 190£ 6s.

11. Reduce $75 to pounds, New England currency.

Ans. £22 10s.

12. Reduce $384 to pounds, Nova Scotia currency.

Ans. 96£.

SIMPLE PROPORTION.

In this rule there are three terms given to find a fourth that shall have the same proportion to the demand, that the denomination corresponding with the answer does to the denomination corresponding with the demand. The demand may frequently be known by questions like the following, viz: How much? How many? What cost? What will, &c.

Rule. In stating, notice whether the demand and its corresponding term be of the same denomination, if so, place the demand first on the right hand side of the line, and its corresponding term immediately opposite on the left, a

the remaining term which must be of the same denomination with the answer on the right hand side and the last mentioned. But, if the demand and its corresponding term be not of the same denomination, and the remaining term be not of the same denomination of the required answer, they may be reduced to the same denomination by the following rule:

First, write the demand on the right hand side of the line, then write the numbers necessary to reduce that quantity to the denomination for which the price is given on the right hand side of the line under each other, together with the price, then on the left hand side of the line write the numbers necessary to reduce the said price to the denomination of the required answer.

Note. Notice which of the given terms is of the same kind or name as the required answer, and place it on the right hand side of the line. Notice again whether the required term must be greater or less than this, and if greater, place the greater of the two remaining terms under the preceding term, and also on the right of the line, and the less of the two terms on the left, but if less, place the less of the remaining terms on the right of the line, and the greater on the left, then proceed as before.

EXAMPLES.

1. If 3 yards of cloth cost 7 dollars, how many dollars will 9 yards cost?

	yds.	*yds.* demand
corresponding with the demand.	—3	9— 3
		$7 corresponding with the answer.
		$21 *Ans.*

2. If 4 lbs of sugar cost 35 cts., what will 12 lbs cost.

	—4	12— 3
		35
		$1,05 *Ans*

3. If 8 men can mow 15 acres of grass in a given time, how many acres will 48 men mow in the same time?

—8 | 48— 6
| 15

| 90 acres. *Ans.*

4. If 9 yards of cloth cost 63 dollars, how many dollars will 45 yards cost?

—9 | 45
| 63— 7

$315 *Ans.*

5. If 48 men can build a wall in 24 days, how many men can do the same in 192 days.

—8 —192 | 24—
| 48— 6

| 6 men. *Ans.*

6. If 160 poles long and 1 pole wide make an acre, how much in length, that is 8 poles wide, must be taken to contain an acre?

—8 | 1
| 160— 20

| 20 *Ans.*

7. How many men must be employed to finish a piece of work in 15 days, which 5 can do in 24 days?

—3 —15 | 24— 8
| 5—

| 8 *men.* *Ans.*

8. If a man perform a journey in 6 days, when the day is 8 hours long, in how many days will he do it, when the day is 12 hours long?

—2 —12 | 8— 4
| 6—

| 4 *days.* Ans.

9. If I lend my friend $100 for 180 days, how long ought he to lend me $450 to return my kindness?

—5 —450 | 100— 20
| 180— 2

| 40 *days.* *Ans.*

NOTE. Should there fractions occur in any of the examples under this rule, the numerators should be used like whole numbers, that is, the numerators of the 2d and 3d terms should be placed on the right hand side of the lines, and the numerators of the 1st term on the left hand side as in division of fractions, the denominators are always placed opposite their own numerators.

10. If 6 lbs. of iron cost 72 cts., what will $\frac{3}{7}$ of a lb. cost?

7 | 3
—6 | 72— 12

7 | 36=5$\frac{1}{7}$ cts. Ans.

11. A person having $\frac{3}{5}$ of a coal mine, sells $\frac{3}{4}$ of his share for $171, what is the whole valued at?

—3 | 4
—3 | 5
| 171— 19

| $380 Ans.

12. If 7$\frac{1}{2}$ yds. of cloth cost 2$\frac{1}{2}$ dollars, what will 30 yds. cost?

—3 —15 | 30— 10
| 2—
—2 | 5---

| $10 Ans.

13. If 4$\frac{5}{8}$ barrels of flour cost $25, what will 37 barrels cost?

---37 | 37---
| 8
| 25

| $200 Ans.

14. If $\frac{4}{5}$ of $\frac{5}{12}$ of a yard of cloth cost 60 cts., how much will $\frac{1}{9}$ of $\frac{3}{4}$ of $\frac{4}{1}$ yards cost?

---3 ---9	1
---4	3---
---5	24
---4	5---
---5	12---
	60--- 3

| 72 cents. Ans.

15. If $2\frac{1}{6}$ pounds of tobacco cost 26 cents, what will $\frac{3}{4}$ of $\frac{4}{6}$ of 9 pounds cost?

---4	3
---6	4---
	9
---13	6---
	26--- 2

| 54 cents. Ans.

16. If $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{9}$ of a yard of linen cost 18 cents, what will 3 yards cost?

	3
1	2---
---2	3---
---3	4---
---4	9
	18

| $4,86 Ans.

17. If $3\frac{1}{2}$ times $3\frac{1}{2}$ yards of cloth cost $1\frac{1}{2}$ times $1\frac{1}{2}$£s, what is the value of $\frac{1}{2}$ of $\frac{1}{3}$ of $12\frac{1}{2}$ yards?

---2	1
---3	1
---4	49---
---7	2---
---7	2---
---2	3---
2	3
	20--- 5

2 | 15=7$\frac{1}{2}$ shillings. Ans.

18. If 1 pint of wine cost 10 pence, how many £s will 3 hhds. cost?

hhds.	1	3---	hhds.
gall.	1	63	gall.
qts.	1	4---	qts.
pts.	1	2---	pts.
pence	---3 ---12	10---	pence
shill.	---20	1	shill.
		1	£.

63£. Ans.

NOTE. In the above example the demand is laid on 3 hhds., this we place first on the right hand side of the line, this we reduce to pints by placing the several numbers requisite to reduce hhds. to pints. (See the table of wine measure.) After we have gone to pints, reduction descending on the right, we then place pints opposite on the left, and the price on the right hand; we then proceed to reduce pence to pounds, the denomination required on the left hand, (see pence table) and the denomination £s falls on the right hand side of the line. The name or denomination of which we wish our answer, must always be the last on the right.

19. If 3 pts. port wine cost 9 pence (New England currency,) how many dollars will 3 hhds. cost? (See table.)

	3---
	63
	4---
---3	2---
---12	9---
---6	

$63 Ans.

NOTE. It is not necessary to use the figure 1's, for they are not regarded in the calculation, therefore, they are understood and not expressed.

20. If 2 qts. of cider cost 1 shilling (New York,) how many dollars will 4 hhds. cost?

	4---
	63
---2	4---
---8	
	$63 Ans.

21. If 6 gills cost 3 farthings (New England) how many dollars will 12 hhds. cost?

	12---
	63--- 21
	4---
	2
---6	4---
---4	3---
---3 ---12	
---6	
	$12 Ans.

22. If 3 qts. of oil cost 6 shillings (New York,) how many dollars will 2 tuns cost?

	2---
	2---
	2---
	63
---3	4
---8	6--- 2
	$504 Ans.

23. If 4 lbs. of tobacco cost 2 shillings (New York,) how many dollars will 8 cwt. cost?

	8---
	4---
---4	28
---8	2
	$56 Ans.

24. If 9 lbs. of nails cost 6 shillings (New York,) how many dollars will 30 tons cost?

	3--- 0
	2--- 0
	4---
---3 ---9	28
---8	6--- 2

\$5600 Ans.

25. If 4 quarts of oats cost 16 pence, how many dollars will 60 bushels cost, New Jersey currency? Ans. \$85⅓.

26. If 3 pecks of beans cost 7 pence, how many dollars will 9 bushels cost, South Carolina currency? Ans. \$1½.

27. If 12 drams of opium cost 30 pence, how many dollars will 6 pounds cost, New York currency? Ans. \$15.

28. If 12 grains of silver be worth 1 shilling, what is the value of a silver tankard, weighing 4 pounds?

Ans. \$256.

29. Bought a piece of cloth for £16½, at 15 shillings per yard, how many yards did it contain? Ans. 22 yds.

30. If 1½ yards of cloth cost 2½ dollars, how many cents cost 1½ quarter of a yard? Ans. 62½ cts.

31. If $\frac{2}{3}$ of a yard cost $\frac{3}{10}$ of a dollar, how many cents cost $\frac{7}{15}$ of a yard? Ans. 21 cts.

32. When 19⅕ pounds of sugar cost $\frac{9}{10}$ of a £, how many pounds can I have for $\frac{5}{8}$ of a shilling? Ans. $\frac{2}{3}$ lb.

33. If 8⅘ of a lb. of starch cost $\frac{3}{5}$ of a £, how many pounds of starch can I have for 72 cents, New Jersey currency? Ans. 6 lbs.

34. If $\frac{3}{5}$ of a yard of cloth be worth $\frac{2}{3}$ of two dollars and 28 cents, what is the value of 7 yards?

Ans. \$17,73⅓ cts.

35. If ½ of a yard of cloth, $\frac{3}{4}$ wide, cost 2¼ dollars, what is the value of 2½ yards, 1½ wide. Ans. \$22½.

36. If $\frac{3}{4}$ of ¼ of the cargo of a ship be worth 250 dollars, what is the value of the whole cargo? Ans. \$1333⅓.

37. If 4 pounds of nails cost 18 pence, how many dollars will 12 tons cost, New York currency? Ans. \$1260.

38. If $\frac{3}{7}$ of $\frac{4}{11}$ of $\frac{7}{8}$ of a ship be worth $\frac{1}{9}$ of $\frac{8}{7}$ of $1\frac{1}{3}$ of the cargo valued at 12000 dollars, what did both ship and cargo stand the owner in? Ans. \$15223,44⅔, cts.

39. If $\frac{4}{5}$ of $\frac{5}{8}$ of $\frac{5}{7}$ of $\frac{7}{12}$ of a ship be worth $\frac{7}{10}$ of $\frac{3}{7}$ of $\frac{4}{5}$ of $\frac{8}{9}$ of the cargo valued at $15000, what did both ship and cargo stand the owner in? Ans. $23000.

40. If 12 men build a house in 48 days, in what time could 36 men build it? Ans. 16.

41. Admit that I lend a friend on his occasion 100 dollars for six months, and he promised me the like kindness when I desired it; but, when I come to request it, he could lend me only 75 dollars. The question is, how long must I keep the 75 dollars to recompense my courtesy to him?

After the direct pure proportion, the demand would be laid upon 75 dollars; but we invert or change, and lay the demand upon the 100. Ans. 8 mo.

42. If I lend my friend 100 dollars for 6 months, allowing the month to be 30 days, how many days ought he to lend me 1000 dollars? Ans. 18 days.

43. If, for 48 shillings, 225 cwt. be carried 512 miles, how many cwt. may be carried 64 miles for the same money? Ans. 1800 cwt.

44. If, when wheat is 83 cents per bushel, the cent loaf weighs 9 oz., what ought it to weigh when wheat is 1 dollar 24½ cents per bushel? Ans. 6 oz.

45. There is a cistern having a cock which will empty it in 12 hours, how many cocks of the same capacity will empty it in $\frac{1}{4}$ of an hour? Ans. 48.

46. A gentleman purchased 24 yards of cloth, at 3 shillings per yard. Required the cost in dollars and cents, New York currency. Ans. $9.

47. Purchased 36 yards of satin at 4s. 6d. per yard. Required the cost in dollars and cents, New England currency. Ans. $27.

48. A gentleman bought 108 pounds of tea, at 7s. 6d. per pound. What was the cost in dollars and cents, New Jersey currency? Ans. $108.

49. Required the cost of 28 pounds of young hyson tea, at 6s. 8d. per pound, in dollars and cents, South Carolina currency? Ans. $40.

50. A man bought 3 hogsheads of molasses, each hogshead contained 120 gallons, at 1s. 8d. per gallon. Required the cost in federal money, New York currency.

Ans. $75.

51. A gentleman purchased 8 hogsheads of oil, each hogshead contained 140 gallons, at 6s. 2d. per gallon. Required the cost in federal money, New England currency. Ans. $1151\frac{1}{9}$.

52. Purchased 4 pieces of cloth, each piece containing 30 yards, at 1s. 4d. per yard. Required the cost in federal money, New Jersey currency. Ans. $21\frac{1}{3}$.

53. A gentleman bought 2 bales of cloth, each bale contained 42 pieces, and each piece 30 yards, at 2s. 6d. per yard. Required the cost in federal money, South Carolina currency. Ans. $1350.

54. A gentleman purchased 12 hogsheads of molasses, each hogshead contained 120 gallons, at 3s. 4d. per gallon, and paid for the same with cloth, at 6s. 8d. per yard. Required the number of yards he gave in exchange.

Ans. 720 yards.

55. A merchant bought 12 tons of iron, at 4d. per pound, and paid for the same with molasses, for which he was allowed 2s. 4d. per gallon. Required the number of hogsheads he gave in exchange, allowing each hogshead to contain 80 gallons. Ans. 48.

56. A gentleman purchased 6 tons of bar iron, at 6d. per pound, (New York currency,) and paid for the same with candles, for which he was allowed 15s., (New England currency,) per box. How many boxes of candles were required? Ans. 336.

57. A philanthropist distributed a certain amount of money among 42 poor widows, giving them each 4s. 2d. Required the amount of his distribution in federal money, South Carolina currency. Ans. $37,50.

58. Supposing the circumference of a wheel to be 15 feet, how many times will it revolve in going from Boston to Dedham, the distance being 10 miles? Ans 3520 times.

59. How many times did Captain Cook sail the length of his vessel in circumnavigating the globe, the circumference being 24,800 miles, and the length of the vessel 240 feet? Ans. 545600 times.

60. The circumference of a large wheel is 36 feet, and that of a small one is 18 inches. How many more revolutions will the latter make than the former, in going from Schenectady to Rochester, the distance being 140 miles? Ans. 472 266+.

61. The distance from Lowell to Boston is 26 miles, allowing the average width of the road to be 4 rods, how many acres would be contained therein? Ans. 208 acres.

62. If 3 yards of cloth cost 7 dollars, how many dollars will 9 yards cost? Ans. $21.

63. What will 12 pounds of sugar cost if 4 pounds cost 35 cents? Ans. $1,05 cts.

64. If 3 yards of cloth cost 15 dollars, how many dollars will 12 yards cost? Ans. $60.

65. If 8 men mow 15 acres of grass in 3 days, how many acres will 48 men mow, in the same length of time? Ans. 90 acres.

66. If 4 yards of cloth cost $8, what will 26 yards cost? Ans. $52.

67. If 2 yards of muslin cost 46 cents, what will 8 yards cost? Ans. $1 84.

68. If 7 horses consume 21 bushels of oats in 3 days, how many bushels will 3 horses consume in the same time? Ans. 9 bush.

69. If 28 lbs. of butter cost $5 88, what will 7 lbs. cost? Ans. $1 47.

70. If 3 yards of cloth cost $9, how many yards will $243 buy? Ans. 81 yards.

71. What will 30 lbs. of sugar cost, when 45 cents will buy 5 lbs. Ans. $2 70.

72. If 20 yards cost $120, how many yards may I have for $30? Ans. 5 yards.

73. If 7 lbs. of sugar cost 56 cents, how much will $7 12 buy? Ans. 89 lbs.

74. If 3 cords of wood cost $4 35, what will 27 cords cost? Ans. $39 15.

75. If 4 yards of cloth cost $35 50, how many yards may be bought for $106 50? Ans. 12 yards.

76. If 12 yards cost $9 72, what will 192 yards cost? Ans. $155 52.

77. How many bushels of wheat can be bought for $24, when 6 bushels cost $9? Ans. 16 bush.

78. If 7 lbs. of sugar cost 63 cts., what will 25 lbs. cost? Ans. $2 25.

79. If a man can travel 15 miles in 3 hours, how many *miles can he* travel in 5 hours? Ans. 25 miles.

80. How many laborers must be employed to finish a piece of work in 15 days, which 5 men can do in 24 days?
Ans. 8 men.

81. If 12 men can build a house in 30 days, how many will do it in 8 days? Ans. 45 men.

82. If a man perform a journey in 6 days, when the day is 8 hours long, in what time can he do it when the day is 12 hours long? Ans. 4 days.

83. If I lend my friend $100 for 180 days, how long ought he to lend me $450 to return my kindness?
Ans. 40 days.

84. If 13 men can perform a piece of work in 35 days, in how many days would 5 men perform the same work?
Ans. 91 days.

85. If 7 men do a piece of work in 16 days, how many men can do it in 4 days? Ans. 28 men.

86. If 20 horses eat 35 bushels of oats in a week, how many bushels will 8 horses eat in the same time?
Ans. 14 bushels.

87. If 20 men can mow a field in 34 days, how many men can mow it in 8 days? Ans. 85.

88. If 8 men can build a wall in 20 days, how long will it take 5 men to build it? Ans 32 days.

89. If 20 men can perform a piece of work in 35 days, how many men can do it in 7 days?
Ans. 100 men.

90. If 12 oxen can eat 5 acres of grass in a week, how many acres will it take to keep 36 oxen the same time?
Ans. 15 acres.

91. If my friend lends me $300 for 36 days, how long should I lend him $80 to repay his kindness?
Ans. 135 days.

92. Suppose a man paints a house in 45 days, and works 8 hours a day, how long would it take him if he worked 9 hours a day? Ans. 40 days.

93. A man borrows of his friend $280, which he keeps 40 days; how much must he lend his friend 70 days as an equivalent? Ans. $160.

94. It takes 84 yards of paper that is 32 inches wide, to cover the walls of a room; how many yards will it take to cover another room of the same size, when the paper is *24 inches wide*? Ans. 112 yards.

95. How much in length, $4\frac{1}{2}$ inches broad, will make a foot square? Ans. 32 inches.

96. There is a cistern, having a pipe which will empty it in 15 hours; how many pipes of the same capacity will empty it in 3 quarters of an hour? Ans. 20 pipes.

97. What is the height of a tree, whose shadow is 180 feet, when a staff 5 feet long casts a shadow 9 feet? Ans. 100 feet.

98. If 12 pears are worth 21 apples, and 3 apples cost a cent, what will be the price of four score and four pears? Ans. 49 cts.

99. If a field will feed 6 cows 91 days, how long will it feed 21 cows? Ans. 26 days.

100. If 50 gallons of water in 1 hour fall into a cistern containing 230 gallons, and by a pipe in the cistern 35 gallons run out in an hour, in what time will it be filled? Ans. $15\frac{1}{3}$ hours.

101. If 1 pint of wine cost 10 pence, how many £ will 3 hogsheads cost at that rate? Ans. 63£.

102. If 1 gill of cider cost 3 pence, how many £ will 20 gallons cost? Ans. 8£.

103. If 1 quart of vinegar cost 8 pence, how many £ will 5 hogsheads cost? Ans. 42£.

104. If 4 pounds of nails cost 18 pence, how many £ will 12 tons cost? Ans. 504£.

105. If 12 tons of nails cost 504£, how many pence will 4 pounds cost? Ans. 18 pence.

106. If 3 hogsheads of wine cost 63£, what will 1 pint cost? Ans. 10 pence.

107. If 4 pounds of iron cost 18 pence, how many dollars (New England currency) will 12 tons cost at the same rate? Ans. $1680.

108. If 12 tons of iron cost 1680 dollars, (New England currency,) how many pence will four pounds cost? Ans. 18 pence.

109. If 18 pence will buy 4 pounds, how many tons can be purchased for 1680 dollars (New England currency? Ans. 12 tons.

110. If 1680 dollars (New England currency) will buy 12 tons of iron, how many pounds can be purchased for 18 *pence?* Ans 4 pounds.

111. If 9 pounds of nails cost 6 shillings, (New York currency,) how many dollars will 30 tons cost?

Ans. $5600.

112. If 8 gallons of N. E. Rum cost 4 dollars, how many £ (N. Y. currency) will 15 pipes cost?

Ans. £378.

113. If 4 qts. of oats cost 16 pence, (New Jersey currency,) how many dollars will 60 bushels cost?

Ans. $8 53 33+.

114. If 3 pecks of beans cost 7 pence, (South Carolina currency,) how many dollars will 9 bushels cost?

Ans. $1 50.

115. If $\frac{3}{4}$ of a yard of cloth cost 6 dollars, what will 9 yards cost? Ans. 72 dolls.

116. If $\frac{7}{8}$ of a yard of cloth cost 14 dollars, what will 4 yards cost? Ans. 64 dolls.

117. If $\frac{1}{2}$ of $\frac{2}{3}$ of a yard of silk cost 6 shillings, what will 3 yards cost? Ans. 54s.

118. If $\frac{4}{5}$ of $\frac{5}{6}$ of a yard of ribbon cost 18 cents, what will 7 yards cost? Ans. $2 52.

119. If $\frac{1}{3}$ of $\frac{2}{5}$ of $\frac{3}{4}$ of a yard of silk cost 50 cents, what will $\frac{1}{2}$ of 8 yards cost? Ans. 20 dolls.

120. If $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of a yard of satin cost 1 dollar, what will $\frac{3}{4}$ of $\frac{4}{5}$ of 5 yards cost? Ans. 12 dolls.

121. If $\frac{2}{3}$ of $\frac{3}{4}$ of $2\frac{1}{2}$ yards of cassimere cost $\frac{1}{2}$ of 5 dollars, what will 2 yards cost? Ans. 4 dolls.

122. If $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of 6 yards of satinet cost 84 cents, what will $\frac{4}{5}$ of $\frac{6}{9}$ of $\frac{5}{6}$ of 9 yards cost? Ans. $89\frac{3}{8}$ cents.

123. If $\frac{6}{8}$ of $\frac{4}{6}$ of $\frac{8}{9}$ of $\frac{9}{10}$ of $3\frac{1}{3}$ yards of broadcloth cost $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of 4 dollars, what will $\frac{7}{12}$ of $\frac{1}{2}$ of $4\frac{4}{5}$ yards cost?

Ans. $ 1 05, or $\frac{1}{20}$.

124. If $\frac{5}{6}$ of $\frac{3}{7}$ of $\frac{8}{12}$ of $\frac{7}{8}$ of 12 yards of petersham cost $\frac{7}{8}$ of $\frac{9}{10}$ of $\frac{8}{9}$ of 10 dollars, what will $\frac{3}{4}$ of $3\frac{1}{3}$ yards cost?

Ans. $9\frac{1}{3}$ dolls.

125. If $\frac{1}{7}$ of 7 yards of cloth cost 49 cents, what will $\frac{6}{7}$ of $\frac{8}{9}$ of $\frac{7}{8}$ of 8 yards cost? Ans. $ 2 $61\frac{1}{3}$.

COMPOUND PROPORTION.

Rule. In compound proportion, we have five terms given to find a sixth, three of which are a supposition, and two a demand. Place the two terms of demand on the right hand side of the line, then place those in the supposition of the same name directly opposite on the left, observing to let the term of the same name of the answer stand on the right hand side of the line, and the last mentioned.

Note. When the *effect* of the cause is required, the question is in direct proportion, but when the *cause* is required, the question is in inverse proportion. Attention and practice will enable the pupil to apply the criterion with accuracy and facility. When the question is inverse, all positions of the cause change place over the line. Observe, the effect never changes place, neither the answer required. Causes are men, horses, time, days, years, hours, capital or sum, length breadth, heighth, or any thing that produces an effect, as length, breadth and heigth, are causes of solid contense. The effect is that which is produced by the cause, as the work done, the grain consumed, the distance travelled, the money for the work, &c. By the positions above mentioned, we mean all the causes mentioned in the example, with the exception of the one required.

EXAMPLES.

1. If 10 bushels of oats be sufficient for 18 horses 20 days, how many bushels will serve 60 horses 36 days?

---18	60
---20	36--- horses
	10---
	60 Ans.

Note. In the above example it is required to know how many bushels of oats will serve the horses, consequently *the effect of the* cause is required; therefore the question *is in direct* proportion, and no positions change place.

But had it been required to know how many horses would have consumed the oats in a given time, then the question would have been in inverse proportion, and the time would have been the position of the cause.

2. If 7 men can reap 84 acres of rye in 12 days, how many men will reap 100 acres in 5 days?

As in direct:

84	100
12	5
	7

---84	100--- 20
---5	12--- positions
	7--- changed, viz. days.

20 men, Ans.

Note. In the above example we have two causes, viz., men and days, the men being required; the other cause, viz., the days become positions, therefore change places.

If the pupil will pay strict attention to the statement and solution of the six following examples, he will be enabled to determine at sight whether a question be in direct or inverse proportion.

You may write the cause and effect under letters representing them, the extremes being placed on the same side of the line, and the means on the opposite. Thus, take the first example:

C	E
18	10
20	

C	E
60	0
36	

---18	60
---20	36---
	10---

60 Bushels.

In the above it will be observed, that in all examples under this rule, the supposition is full and complete, and the deficiency in the demand must be supplied with the answer when obtained: if your blank in the demand fall under the effect, then place your extremes for a divisor, and your means for a dividend; but if the blank fall under the cause, then place your means for a divisor, and your extremes for a dividend, as in the next example.

C	E	C	E
7	84	5	100
12		0	

---84 | 100--- 20
---5 | 12---
| 7---

| 20 men.

3. If 4 compositors, in 16 days of 12 hours long, can compose a work of 14 sheets, of 24 pages in each sheet, 44 lines in a page, and 40 letters in a line; in how many days of 8 hours long may 12 compositors compose a volume, to be printed on the same letter, consisting of 42 sheets, 16 pages on a sheet, 48 lines in a page, and 55 letters in a line?

C	E	C	E
4	14	8	42
16	24	12	16
12	44	0	48
	40		55

---14 | 42--- 3
---24 | 16--- 4
---4 ---44 | 48--- 2---
---40 | 55--- 5---
—12 | 4---
---8 | 12---
| 16--- 2

| 24 Days, Ans.

4. If 4 men can mow 12 acres of grass in 3 days, how many acres can 16 men mow in 9 days?

—4 | 16
—3 | 9
| 12—

| 144 acres, Ans.

5. If 4 men can mow 12 acres of grass in 3 days, how many men must be employed to mow 144 acres in 9 days?

—12 | 144— 16
—9 | 3—
| 4—

| 16 men, Ans.

6. If 16 men can mow 144 acres of grass in 9 days, how many men must be employed to mow 12 acres in three days?

—144 | 12— 4
—3 | 9—
| 16—

| 4 men, Ans.

7. If 16 men can mow 144 acres of grass in 9 days, in how many days can 4 men mow 12 acres?

—4 | 16—
—144 | 12— 3
| 9—

| 3 days, Ans.

8. If 16 men can mow 144 acres of grass in 9 days, how many acres can 4 men mow in 3 days?

—16 | 4
—9 | 3
| 144—

| 12 acres.

9. If 4 men can mow 12 acres of grass in 3 days, in how many days can 16 men mow 144 acres?

—16 | 4—
—12 | 144— 9
| 3—

9 days, Ans.

10. If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, what will be the length of that wall which 18 men can build in 30 days, the width being 8 feet, and heighth 6 feet?

Statement.

6	18
15	30
6	8
4	6
	80

Solution.

—6	18— 3
—15	30— 2
—8	6—
—6	4
	8— 0

240 Length, Ans.

Note. Length being required, change width and heighth; width required, change length and heighth; heighth required, change length and width.

If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, what will be the width of that wall which 18 men can build in 30 days, the length being 240 feet, and the heighth 6 feet?

6	18
15	30
80	240
4	6
	6

—6	18—
—15	30— 2
—3 —240	80—
—6	4
	6—

8 feet wide, Ans.

11. If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, what will be the heighth of that wall which 18 men can build in 30 days, the length being 240 feet, and the width 8 feet?

6	18
15	30
80	240
6	8
	4

—6	18— 3—
—15	30— 2—
—240	80—
—8	6
	4—

6 feet high, Ans.

12. If a cellar $22\frac{1}{2}$ feet long, $17\frac{3}{10}$ feet wide, and $10\frac{1}{4}$ feet deep, be dug in $2\frac{1}{2}$ days by 6 men, working $12\frac{3}{10}$ hours a day, how many days, of $8\frac{1}{5}$ hours, should 9 men take to dig another, measuring 45 feet long, $34\frac{3}{5}$ wide, and $12\frac{3}{10}$ feet deep?

Statement.		Solution.	
5	41	—10	123— 3—
123	10	—41	5—
6	9	—9	6
	45		45—
45	2	—45	2—
5	173	—173	10—
173	10	—5	173—
10	123	—41	4— 2
41	4	—2 —10	123— 3—
2	5	—2	5—

12 days, Ans.

13. If 8 horses consume 36 bushels of oats in 9 days, how many bushels will 24 horses consume in 12 days?

Ans. 144.

14. If 8 horses consume 36 bushels of oats in 9 days, how many horses will be required to consume 144 bushels in 12 days? Ans. 24 horses.

15. If 8 horses consume 36 bushels of oats in 9 days, in what time will 24 horses consume 144 bushels?

Ans. 12 days.

16. If 24 horses consume 144 bushels of oats in 12 days, how many bushels of oats will 8 horses consume in nine days? Ans. 36 bush.

17. If 24 horses consume 144 bushels of oats in 12 days, in what time will 8 horses consume 36 bushels?

Ans. 9 days.

18. If 24 horses consume 144 bushels of oats in 12 days, how many horses will be required to consume 36 bushels in nine days? Ans. 8 horses.

19. If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, how many men must be employed to build one 240 feet long, 8 feet wide, and 6 feet *high, in 30 days?* Ans. 18 men.

20. If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, in what time can 18 men build one 240 feet long, 8 feet wide, and 6 feet high?

Ans. 30 days.

21. If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, what will be the length of that wall which 18 men can build in 30 days, the width being 8 feet, and height 6 feet? Ans. 240 feet.

22. If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, what will be the width of that wall which 18 men can build in 30 days, the length being 240 feet, and the height being 6 feet? Ans. 8 feet.

23. If 6 men can build a wall 80 feet long, 6 feet wide, and 4 feet high, in 15 days, what will be the height of that wall which 18 men can build in 30 days, the length being 240 feet, and the width 8 feet? Ans. 6 feet.

24. If 18 men can build a wall 240 feet long, 8 feet wide, and 6 feet high, in 30 days, how many men must be employed to build one 80 feet long, 6 feet wide, and 4 feet high, in 15 days? Ans. 6 men.

25. If 18 men can build a wall 240 feet long, 8 feet wide, and 6 feet high, in 30 days, in what time will 6 men build one 80 feet long, 6 feet wide, and 4 feet high?

Ans. 15 days.

26. If 18 men can build a wall 240 feet long, 8 feet wide, and 6 feet high, in 30 days, what will be the length of that wall which 6 men can build in 15 days, the width being 6 feet, and height 4 feet? Ans. 80 feet.

27. If 18 men can build a wall 240 feet long, 8 feet wide, and six feet high, in 30 days, what will the width of that wall be which 6 men can build in 15 days, the length being 80 feet, and the height 4 feet? Ans. 6 feet.

28. If 18 men can build a wall 240 feet long, 8 feet wide, and 6 feet high, in 30 days, what will the height of that wall be which 6 men can build in 15 days, the length being 80 feet, and width 6 feet? Ans. 4 feet.

29. Lent a friend $800 for 6 months, and at the expiration of the time received the interest, which was 48 dollars, at what rate per cent. per annum did I receive interest? Ans. 12 cents.

30. If 960 dollars defray the expenses of 20 men 88

weeks, for how many weeks will $1440 defray the expenses of 48 men, if they spend at the same rate?

Ans. 55 weeks.

31. Suppose 4 men in 12 days mow 48 acres, how many acres can 8 men mow in 16 days?

Ans. 128 acres.

32. If 10 bushels of oats be sufficient for 18 horses 20 days, how many bushels will serve 60 horses 36 days?

Ans. 60 bushels.

33. If 4 dollars be the hire of 8 men for 3 days, how many days must 20 men work for 40 dollars?

Ans. 12 days.

34. If 8 men can build a wall 24 feet long, 14 feet high, and 4 wide, in 18 days, in how many days will 15 men build a wall 175 feet long, 8 feet high, and 6 wide?

Ans. 60 days.

35. If a footman travel 240 miles in 12 days, when the days are 12 hours long, how many days will be required to travel 720 miles, when the days are 16 hours long?

Ans. 27 days.

36. If 14 men can dig a ditch 36 feet long, 7 wide, and 8 deep, in 16 days, how many men will it take to dig another ditch 240 feet long, 9 wide, and 5 deep, in 10 days? Ans. 120 men.

37. If to make $2\frac{1}{2}$ yards of cloth 6 quarters wide it requires 12 ounces of wool, how much wool will it take to make 140 yards, 4 quarters wide? Ans. 28 lbs.

38. If 300 men, in six months, perform a piece of work, when the days are 12 hours long, how many men will do the same in 4 months, when the days are 8 hours long?

Ans. 675.

39. If the transportation of 12 cwt. 3 qrs. for 400 miles cost 57 dollars 12 cents, what will the transportation of 10 tons for 75 miles amount to? Ans. $168,00 cts.

40. An usurer put out 150 dollars at interest; and when it had been on interest 8 months, he received for principal and interest 160 dollars; at what rate per cent. per annum did he receive interest? Ans. 10 per cent.

41. If 8 men can build a wall 20 feet long, 6 feet high,

and 4 feet thick, in 12 days, in what time will 24 men build one 200 feet long, 8 feet high, 6 feet thick?

Ans. 80 days.

42. Suppose 12 men consume 240 pounds of bread in 8 days, how many men will consume 360 pounds in one day? Ans. 144.

43. How many men can complete a trench of 135 yards long in 8 days, when 16 men can dig 54 yards in 6 days?

Ans. 30.

44. If 16 bushels of oats serve 9 horses 6 days, how many bushels would 27 horses consume in 11 days?

Ans. 88.

45. If a footman travels from New York to Boston, which is 250 miles, in 8 days, when the days are 12 hours long, in how many days may he travel from New York to Charleston, South Carolina, which is 925 miles, when the days are 16 hours long? Ans. $22\frac{1}{5}$.

46. If 2 horses consume as much corn as 5 oxen, and 12 horses consume 56 bushels in 20 days, how many bushels will 18 oxen consume in 25 days? Ans. 42.

47. If 2 barrels of beer be sufficient to last a family of 14 persons 24 days, how many barrels will be drunk out by a family of 24 persons in one year? Ans. $52\frac{1}{7}$.

48. If 248 men, in 5 days, of 11 hours each, can dig a trench 230 yards long, 3 wide, and 2 deep, in how many days, of 9 hours each, will 24 men dig a trench 420 yards long, 5 wide, and 3 deep? Ans. $288\frac{59}{207}$.

49. If 56 pounds of bread be sufficient for 7 men 14 days, how much bread will serve 21 men 3 days?

Ans. 36 lbs.

50. If 4 reapers receive \$11,04 cts. for 3 days' work, how many men may be hired 16 days for \$103,04 cts.?

Ans. 7.

51. If 20 bushels of wheat are sufficient for a family of 8 persons 5 months, how much will be sufficient for 4 persons 12 months? Ans. 24.

52. If 30 men perform a piece of work in 20 days, how many men will accomplish another piece of work 4 times as large, in a fifth part of the time? Ans. 600.

53. If 7 men can build 36 rods of wall in 3 days, how *many rods* can 20 men build in 14 days? Ans. 480.

54. If 40 men, in 10 days, can reap 200 acres of grain, how many acres can 14 men reap in 24 days? Ans. 168.

55. If 4 men mow 96 acres of grass in 12 days, how many acres can 8 men mow in 16 days? Ans. 256.

56. If a family of 8 persons, in 24 months, spend 480 dollars, how much would 16 persons spend in 8 months? Ans. $320.

57. If 7 quarts of malt are sufficient for a family of 7 persons for 4 months, how many quarts are enough for 46 persons 10 months? Ans. 115.

58. If 8 reapers have £$3\frac{1}{5}$ for 4 days' work, how much will 48 men have for 16 days' work? Ans. £$76\frac{4}{5}$.

59. If a footman travels 240 miles in 12 days, when the days are 12 hours long, how many days may he travel 720 miles in, of 16 hours long? Ans. 27.

60. If 9 students spend in 18 days £$10\frac{2}{7}$, how many dollars, New Jersey currency, will 63 students spend in 30 days? Ans. 320.

61. If 30 shillings be the hire of 8 men for 3 days, how many days must 20 men work for £15? Ans. 12.

62. If 4 reapers have 24 shillings for 3 days' work, how many men will earn £$4\frac{4}{5}$ in 16 days? Ans. 3.

63. If 9 men reap 18 acres in 3 days, how many acres will 27 men reap in 6 days? Ans. 108.

64. If 25 men, by working 10 hours a day, can dig a trench 36 feet long, 12 feet broad, and 6 feet deep, in 9 days, how many hours a day must 15 men work, in order to dig a trench 48 feet long, 8 feet broad, and 5 feet deep in 12 days? Ans. $9\frac{7}{27}$.

65. If a man travels 60 miles in 5 days, by travelling 3 hours each day, how far will he travel in 10 days, by travelling 9 hours each day? Ans. 360.

66. If 5 men can build 10 rods of wall in 6 days, how many rods can 20 men build in 18 days? Ans. 120.

67. If 4 men receive 24 dollars for 6 days' work, how much will 8 men receive for 12 days' work? Ans. $96.

68. If 4 men receive 24 dollars for 6 days' work, how many men may be hired 12 days for 96 dollars? Ans. 8.

69. If 8 men, in 12 days, receive 96 dollars, how much will 4 men receive for 6 days' work? Ans. $24.

70. If 8 men receive 96 dollars for 12 days' work, how *long may* 4 *men* be hired for 24 dollars? Ans. 6.

71. If 9 persons in a family spend 1512 dollars in one year, how much will 3 of the same family spend in four months? Ans. $168.

72. If 2000 dollars will support a garrison of 150 men 3 months, how long will 6000 dollars support 4 times as many men? Ans. 2¼.

73. If 144 men, in 6 days, of 12 hours each, dig a trench 200 feet long, 3 feet wide, and 2 feet deep, how many hours long is the day when 30 men dig a trench 350 feet long, 6 feet wide, and 3 feet deep in 259½ days? Ans. 7.

74. There was a certain edifice completed in one year, by 20 workmen; but the same being demolished, it is necessary that just such an one should be built in 5 months; I demand the number of men to be employed about it? Ans. 48.

75. If 8 men spend 32 pounds in 13 weeks, what will 24 men spend in 52 weeks? Ans. £384.

76. A wall, to be raised to the height of 27 feet, was raised to the height of 9 feet by 12 men in 6 days; how many men must be employed to finish it in 4 days? Ans. 36.

77. If 6 laborers dig a ditch 34 yards long in 10 days, how many yards will 20 laborers dig in 15 days? Ans. 170.

78. If a garrison of 600 men have provisions for five weeks, allowing each man 12 oz. per day, how many men may be maintained 10 weeks, with the same provisions, if each man is limited to 8 oz. per day? Ans. 450.

79. If 3 bushels and 3 pecks of corn will last a family of 9 persons 22 days, in how many days will 6 persons consume 5 bushels? Ans. 44.

80. If 450 tiles, each 12 inches square, will pave my cellar, how many tiles must I have if they are only 9 inches long and 8 inches broad? Ans. 900.

81. If 12 ounces of wool make 2½ yards of cloth, 6 quarters wide, how much wool is required for 150 yards 4 quarters wide? Ans. 30 lbs.

82. If a bar of iron, 4 feet long, 3 inches broad, and 1½ inches thick weighs 36 lbs., what will a bar weigh that is *6 feet long*, 4 inches broad, and 2 inches thick? Ans. 96.

83. If 14 men can reap 84 acres in 6 days, how many men will reap 44 acres in 4 days? Ans. 11.

84. If a cistern $17\frac{1}{2}$ feet in length, $10\frac{1}{2}$ in breadth, and 13 feet deep, holds 546 barrels of water, how many barrels will fill a cistern that is 16 feet long, 7 feet broad, and 15 feet deep? Ans. 384.

85. If 25 pears can be bought for 10 lemons, and 28 lemons for 18 pomegranates, and 1 pomegranate for 48 almonds, and 50 almonds for 70 chestnuts, and 108 chestnuts for $2\frac{1}{2}$ cents, how many pears can I buy for $1,35 cts.? Ans. $337\frac{1}{2}$.

86. If the interest on 347 dollars for $3\frac{1}{2}$ years be 72 dollars 87 cents, what will be the interest, at the same rate, on 537 dollars for $2\frac{1}{2}$ years? Ans. $80,55.

87. What must be paid for the carriage of 4 cwt. 32 miles, if the carriage of 8 cwt. 128 miles cost 12 dollars 80 cents? Ans. $160.

88. By working 9 hours a day, 5 men hoed 18 acres of corn in 4 days, how many acres will 9 men hoe at that rate in 3 days, working 10 hours a day? Ans. 27.

89. One pound of thread makes 2 yards of linen cloth, 5 quarters wide; how many pounds of thread will be required to make 50 yards, 3 quarters wide? Ans. 15.

90. If 6 men, working 7 hours a day, mowed 28 acres of grass in 4 days, how many men at that rate will mow 16 acres in 8 days, working 6 hours a day? Ans. 2.

91. If 5 men can make 300 pairs of boots in 40 days, how many men must be employed to make 900 pairs in 60 days? Ans. 10.

92. If 3 compositors set $15\frac{1}{2}$ pages in $2\frac{7}{9}$ days, how many will be required to set $69\frac{3}{4}$ pages in $6\frac{1}{4}$ days? Ans. 6.

93. If the wages of 6 men for 14 days be 84 dollars, what will be the wages of 9 men for 11 days? Ans. $99.

94. If 3 lbs. of yarn make 9 yards of cloth, 5 quarters wide, how many lbs. will be required to make a piece of cloth 45 yds. long, and 4 quarters wide? Ans. 12 lbs.

95. If a class of 25 boys perform 1750 examples in arithmetic in 15 hours, how many examples of equal length may a class of 30 boys perform in 18 hours? Ans. 2520.

96. If the use of 100 dollars for 90 days be worth 1 dollar 50 cents, what is the use of 78 dollars worth for 85 days? Ans. 110½.

97. If a man travels 217 miles in 7 days, travelling 6 hours a day, how many miles will he travel in 9 days, if he travels 11 hours a day? Ans. 511½.

98. If a man performs a journey of 1250 miles in 15 days, by travelling 14 hours a day, how many days will it take him to perform a journey of 1000 miles by travelling 13 hours a day? Ans. 12$\frac{12}{13}$.

99. If 10 cows eat 7½ tons of hay in 14 weeks, how many cows will eat 22½ tons in 28 weeks? Ans. 15.

100. If 6 men will mow 35 acres of grass in 7 days, by working 10 hours a day, how many men will be required to mow 48 acres in 5 days, when they work 12 hours a day? Ans. 9$\frac{3}{5}$.

101. If 16 men can build 18 rods of wall in 12 days, how many men must be employed to build 72 rods of the same kind of wall in 8 days? Ans. 96.

102. If 154 bushels of oats will serve 14 horses for 14 days, how long will 406 bushels serve 7 horses?

Ans. 73$\frac{2}{11}$.

103. If 25 men can earn 6250 dollars in 2 years, how long will it take 5 men to earn $11250? Ans. 18 yrs.

104. If 9 men can mow 36 acres of grass in 4 days, how many acres will 19 men mow in 11 days? Ans. 209.

105. If a family of 9 persons spend 450 dollars in 5 months, how much would be sufficient to maintain the family 8 months, if 5 more persons were added?

Ans. $1120.

106. If a stream of water, running into a pond of 190 acres, will raise the pond 10 inches in 12 hours, how much would a pond of 50 acres be raised by the same stream in 10 hours? Ans. 31$\frac{2}{3}$.

107. If 725 bottles hold 4 barrels of wine, how many bottles are required to hold 3 tierces of wine?

Ans. 725.

108. If 12 men can build a brick wall 25 feet long, 7 feet high, and 4 feet thick in 18 days, in how many days will 20 men build a brick wall 150 feet long, 8 feet high, and *5 feet thick?* Ans. 92$\frac{4}{7}$.

109. If 15 men can dig a trench 75 feet long, 8 feet wide, and 6 feet deep in 12 days, how many men must be employed to dig a trench 300 feet long, 12 feet wide, and 9 feet deep in 10 days? Ans. 162.

110. If 175 bushels of corn, when corn is worth 60 cts. per bushel, be given for the carriage of 100 barrels of flour 58 miles, how many bushels of corn, when corn is worth 75 cents per bushel, must be given for the carriage of 90 barrels of flour 200 miles? Ans. $434\frac{14}{15}$.

111. How many acres in a piece of land 560 rods long and 32 rods wide? Ans. 112.

112. How many yards of carpeting that is $\frac{3}{4}$ of a yard wide, are sufficient to cover a floor that is 18 feet wide and 60 feet long? Ans. 160 yds.

113. What is the weight of a pea to a steelyard, which, being suspended 39 inches from the centre of motion, will equipoise 208 lbs. suspended at the draught end $\frac{3}{4}$ of an inch? Ans. 4 lbs.

114. If 17 tons 12 cwt. of iron cost $880, what cost 2 cwt.? Ans. $5.

115. A borrowed of B $250 for 7 months; and, in return, lent him $300; how long ought he to keep it, that the interest of it may be equal to that of the first sum? Ans. $5\frac{5}{6}$ mo.

116. If $\frac{3}{4}$ of a yard of cloth, $\frac{7}{8}$ yard wide, cost £$\frac{2}{5}$, what is the value of $\frac{5}{8}$ of a yard, $1\frac{3}{4}$ yards wide, of the same quality? Ans. $13\frac{1}{3}$ shillings.

117. If £600 principal gain £$33\frac{1}{3}$ interest in $10\frac{2}{3}$ months, in what time will £100 gain £$6\frac{1}{4}$? Ans. 12 mo.

118. If 2 men in $\frac{3}{4}$ of a year expend 56\frac{1}{4}$, how much will defray the expenses of 3 persons for $5\frac{1}{3}$ years at the same rate? Ans. $600.

119. How many men can do as much work in $\frac{4}{10}$ of a month as 16 men can do in $1\frac{1}{2}$ months? Ans. 60.

120. What sum has A at interest, when it yields as much in $7\frac{1}{2}$ months as B's $450 does in 15 months? Ans. $900.

121. When 12 oxen graze $16\frac{1}{4}$ acres of grass in 20 days, how much will suffice 24 oxen 100 days? Ans. $162\frac{1}{2}$.

122. What is the freight of 10,000 bricks from Waldoboro' to Boston, at $1,25 cts. per 2000 lbs., allowing 6 bricks to weigh $26\frac{1}{2}$ lbs.? Ans. $27,60 cts.

123. If a man receive $15 for 1 year's interest of money lent, at 6 per cent. per annum, how much was the sum lent? Ans. $250.

124. If 8 boarders drink a barrel of cider in 12 days, how long would it last, if 4 more came among them? Ans. 8 days.

125. When wheat is sold at 93 cents per bushel, the penny loaf weighs 12 ounces; what must it weigh when the wheat is $1,24 cts. per bushel? Ans. 9 ounces.

126. How many yards of baize, $\frac{3}{4}$ wide, will line a cloak which has in it 12 yards of camlet, $\frac{1}{2}$ a yard wide? Ans. 8 yds.

127. Suppose 400 men in a garrison are provided with provisions for 30 days; how many men must be sent out, if they would have the provisions last 50 days? Ans. 160.

128. If a head of 7 feet of water with 30 mill powers will reduce a pond of 200 acres 8 inches in a day, how much will a head of 6 feet reduce it in the same time? Ans. $9\frac{1}{3}$.

129. If 30 mill powers would reduce a pond of 7 feet head $7\frac{1}{2}$ inches in a day, how much would they reduce a pond of 6 feet $6\frac{3}{4}$ inches head in the same time? Ans. 8 inches.

130. A ship's company, of 15 persons, is supposed to have bread to last their voyage, allowing each 8 ounces per day: when they picked up a crew of 5 persons in distress, to whom they are willing to communicate, what will the daily allowance of each person then be? Ans. 6 ounces.

131. A person engaged to remove 800 tons of timber from Exeter to the navy yard, in Portsmouth. If in 6 days he has removed 450 tons with 36 oxen, how many oxen would be wanted to remove the remainder in 3 days? Ans. 56 oxen.

SIMPLE INTEREST.

RULE. Place the principal, time and rate per cent. on the right hand side of the line. If the time consists of years and months, reduce them to months, and place 12, *(the number of months* in a year) on the left hand side of

the line. Should the time consist of months and days, reduce them to days, or aliquoit parts of a month. If reduced to days, place 30 (the number of days in a month) and 12 on the left. If to aliquoit parts of a month, place 12 only, as above.

EXAMPLES.

1. What is the interest on $60, for 117 days, at 6 per cent?

	60— 2—
—30	117
—12	6—
	$1,17 Ans.

NOTE. When the principal is in dollars and cents cut off 4 figures in your answer from the right for cents, and all to the left are $s; but if your principal be $s only, cut off 2 figures.

2. What is the interest of $96,50 for 90 days, at 6 per cent?

	96— 50— 4825
—30	90— 3
—2 —12	6—
	$1,44,75 Ans.

3. What is the interest of $4,80 for 361 days, at 6 per cent.?

	4,80— 4
—30	361
—12	6— 2
	$,28,88 Ans.

What is the interest of $720 for 9 months, at 7 per cent.?

	720— 60
—12	9
	7
	$37,80 Ans.

5. What is the interest of $960 for 11 months and 20 days, at 6 per cent.?

	960— 80
—3	35
—12	6— 2,
	$56 Ans.

NOTE. In the above example we say 11 months and 20 days make $11\frac{2}{3}$ months, 20 days being $\frac{2}{3}$ of 30, this mixed number we reduce to an improper fraction, making $\frac{35}{3}$ months, writing the numerator on the right, and the denominator on the left of the line.

6. What is the interest of $144,60 for 5 years, 11 months and 27 days, at 6 per cent.?

yrs.	mo.	ds.	mos.		
5	11	27	$=71\frac{9}{10}$		144,60— 723
			$\frac{10}{719}$	—10	719
		—2	—12		6—
		10			
					$51, 98, 37 Ans.

8. Required the interest of 180 dollars for two months and 15 days, at 6 per cent. Ans. $2 25.

9. Required the interest of 180 dollars for 6 months, at 6 per cent. Ans. $5 40.

10. Required the interest of 120 dollars for 8 months, at $3\frac{1}{3}$ per cent. Ans. $2 66,6+.

11. Required the interest of 99 dollars for 2 months, at $4\frac{4}{5}$ per cent. Ans. $ 0 79,2.

12. Required the interest of 60 dollars for 4 months, at 4 per cent. Ans. $ 0 80.

13. Required the interest of 176 dollars for 3 months and 10 days, at 6 per cent. Ans. 2 93,3+.

14. Required the interest of 640 dollars for two months and 19 days.* Ans. $8 42,6+.

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* *When no per cent. is mentioned, 6 per cent. is always understood.*

15. Required the interest of 800 dollars for 4 months and 20 days. Ans. $18 66,6+.

16. Required the interest of 720 dollars for 3 months and 19 days. Ans. $ 13 08.

17. Required the interest of 480 dollars for six months and 5 days. Ans. $ 14 80.

18. Required the interest of $480 for 8 months and 6 days. Ans. $ 0 19,68.

19. Required the interest of $ 720 for 9 months and 9 days. Ans. $ 0 33,48.

20. Required the interest of 480 dollars for 1 year 6 months and 15 days, at 6 per cent. Ans $44 40.

21. Required the interest of $19 20 for 2 years 4 months and 10 days. Ans. $2 72.

22. Required the interest of $384,40 for 3 years 2 months and 20 days. Ans. $74 31,73.

23. Required the interest of $9999 for 2 years 6 months and 20 days. Ans. $15 33,18.

24. Required the interest of $600,48 for 2 years 9 months and 29 days. Ans. $101 98,15+.

25. Required the interest of 480 dollars for 6 years 6 months and 6 days. Ans. $187 68.

36. Required the interest of $960 60 for 4 years 4 months and 15 days. Ans. $252 15,75.

When interest is required on notes or bonds on which partial payments have been made.

Rule. Cast the interest on the principal at the given rate per cent., up to the time of the first payment, then, if the payment exceed the interest, deduct the excess from the principal; but if it be less, set both payment and interest aside, and cast the interest on the same principal to the time of the next payment, or to the time of some payment, which, when added to the preceding payments, will exceed the sum of interest then due, and deduct the sum of these payments from the amount of the principal. The remainder will form a new principal, with which proceed as before, till the time of settlement.

EXAMPLE.

37. For value received, I promise to pay John Smith & Co., or order, fifteen hundred dollars on demand, with interest. JOHN YORK.

January 1st, 1825.

On this note are the following endorsements: Oct. 1st, 1825, three hundred dollars; July 1st, 1827, four hundred and fifty dollars; Sept. 1st, 1828, six hundred and fifty dollars.

What was due on settlement, July 1st, 1830?

yr.	*m.*	*d.*
1825	10	1
1825	1	1
	9	0 time till first payment.

—2	—12	1500— 750 9 6—

$67,50 The interest till first payment, and $1500+67,50=1567,50 amount, and 1567,50—300=$1267,50 the new principal.

y.	*m.*	*d.*
1827	7	1
1825	10	1
1	9	0=time from 1st to 2d payment.

—2	—12	126750— 63375 21 6—

$133,08,75 The interest till 2d payment, then 1267,50+13308,7,5=1400,5875, and 1400,587—450=950,587 the new principal.

1828	9	1
1827	7	1
1	2	0 time from 2d to 3d payment.

—2 —12	950 587 14— 7 6—

| 66,54,109 The interest till the 3d payment, and 950,587+66,541=1017,128, and 1017,128—650=367,128 the new principal.

1830 7 1
1828 9 1

1 10 0 time from 3d payment to settlement.

—2 —12	367,128 22— 11 6—

| 40,384. The interest till time of settlement and 367,128+40,384=407,512. Ans. or sum due on settlement.

38. I have in my possession a note dated April 15, 1833, for $2150,25, on which are the following endorsements; Nov. 8th, 1834, $500; Sept. 1st, 1835, $72364; January 1st, 1837, $378,295, and Oct. 29th, 1837, $850. What amount was due April 15th, 1838? Ans. $138,337.

39. On a note of $767,95, given Dec. 25, 1827, and drawing interest after 90 days, were the following endorsements: January 1st, 1830, $75; March 25, 1831, $565,25. What was due January 1st, 1833? Ans. $294,118.

40. What was due on a note of $2100, dated June 15, 1820, on settlement June 15, 1830. The following sums being endorsed on the back of it: June 30, 1824, $750, and Sept. 30, 1828, $1200 on interest, at 6 per cent?

Ans. 1249,527.

41. For value received of A. M., I promise to pay him or order seven hundred and fifty dollars, with interest, at 6 per cent.

January 1, 1824. G. G. G.

On the above were the following payments, endorsed April 1, 1826, $150; July 1, 1829, $450. What was due *on settlement* Sept. 1st, 1832? Ans. $481,71.

CONJOINED PROPORTION.

RULE. When it is required to find how many of the *first* sort of coin, weight or measure, mentioned in the question, are equal to a given quantity of the last, place the numbers alternately, beginning on the *right* hand side of the line, observing to let the last number stand on the right hand side; but when it is required to find how many of the *last* sort are equal to a given quantity of the *first*, place the numbers alternately, beginning on the *left* hand side of the line, and let the last number stand on the right hand side.

1. If 100 lbs. English make 95 lbs. Flemish, and 19 lbs. Flemish make 25 lbs. at Bologna, how many lbs. English are equal to 50 lbs. at Bologna?

—5 —95	100— 4
—25	19—
	5— 0
	40 lbs. Ans.

2. If 40 lbs. at New York make 48 lbs. at Antwerp, and 30 lbs. at Antwerp make 36 lbs. at Leghorn, how many lbs. at New York are equal to 144 lbs. at Leghorn?

—4 —48	4— 0
—36	3— 0
	144—
	100 lbs. Ans.

3. If 17 lbs. of raisins are worth 20 lbs. of almonds, and 5 lbs. of almonds worth 8½ lbs. of figs, and 37½ lbs. of figs worth 30 lbs. of tamarinds, how many lbs. of tamarinds are equal in value to 42½ lbs. of raisins?

—17	20—
— 5	17—
—2	
—5 —15 —75	2
	30— 6— 2
—2	85— 17
	68 lbs. Ans.

4. *If A can do as much work in 3 days as B can do in 4½ days, and B as much in 9 days as C in 12 days, and C as*

much in 10 days as D in 8 days, how many days work of D are equal to 5 days work of A.

—3 | 9—
—2 |
—9 | 12— 2—
—10 | 8
5—

8 Ans.

5. If 6 braces at Leghorn make 3 ells English, 5 ells English make 9 braces at Venice, how many braces at Leghorn will be equal to 90 braces at Venice? Ans. 100.

6. If 3 dozen pairs of gloves be equal in value to 2 pieces of Holland, 3 pieces of Holland to 7 yards of satin, 6 yards of satin to 2 pieces of Flanders lace, and 3 pieces Flanders lace to 81 shillings, how many dozen pairs of gloves may be bought for 28 shillings? Ans. 2.

7. If 20 braces at Leghorn be equal to 11 vares at Lisbon, and 40 vares at Lisbon to 80 braces at Lucca, how many braces at Lucca are equal to 100 braces at Leghorn? Ans. 110.

8. Suppose 100 pounds of Venice weight is equal to 70 pounds of Lyons, and 60 pounds of Lyons to 50 pounds of Rouen, and 20 pounds of Rouen to 25 pounds of Toulouse, and 50 pounds of Toulouse to 37 pounds of Geneva, how many pounds of Geneva are equal to 25 pounds of Venice? Ans. $13\frac{47}{98}$.

9. If one French crown is equal in value to 80 pence of Holland, and 83 pence of Holland to 48 pence English, and 40 pence English to 70 pence of Hamburgh, and 64 pence of Hamburgh to 1 florin of Frankfort, how many florins of Frankfort are equal to 166 French crowns? Ans. 210.

10. If 70 braces at Venice are equal to 75 braces at Leghorn, and 7 braces at Leghorn are equal to 4 yards of the United States, how many braces at Venice are equal to 64 yards in the United States? Ans. $104\frac{8}{13}$.

11. A merchant in St. Petersburgh owes 1000 ducats in Berlin, which he wishes to pay in rubles by the way of Holland; and he has for the data of his operation the following information, viz., that one ruble gives $47\frac{1}{2}$ stivers; that 20 stivers make one florin, $2\frac{1}{2}$ florins 1 rix dollar of

Holland, that 100 rix dollars of Holland fetch 142 rix dollars of Prussia, and that 1 ducat in Berlin is worth 3 rix dollars Prussian; how many rubles will pay the debt?

Ans. $2223\frac{173}{1349}$.

12. If 94 piasters at Leghorn are equal to 100 ducats at Venice, and 1 ducat is equal to 320 maravadies at Cadiz, and 272 maravadies are equal to 630 reas at Lisbon, and 400 reas are equal to 50 pence at Amsterdam, and 56 pence are equal to 3 francs at Paris, and 9 francs are equal to 94 pence at London, and 54 pence are equal to a dollar in the United States, how many dollars are equal to 800 piasters? Ans. $816\frac{52}{153}$.

13. If 140 braces at Venice be equal to 150 braces at Leghorn, and 7 braces at Leghorn be equal to 4 American yards, how many American yards are equal $52\frac{4}{15}$ Venetian braces? Ans. 32.

14. A merchant in London has credit for 500 piasters in Leghorn, for which he can draw directly at 52 pence sterling per piaster: but choosing to have it remitted by a circular route, they are sent, by his order, to Venice at 95 piasters for 100 ducats banco; from thence to Cadiz at 350 maravadies per ducat banco; from thence to Lisbon at 630 reas per piaster of 272 maravadies; from thence to Amsterdam at 48 pence Flemish for 400 reas; from thence to Paris at 54 pence Flemish per crown; and from thence to London at 30 pence sterling per crown. What is the arbitrated price between London and Leghorn per piaster, and what is gained or lost by this circular remittance, without reckoning expenses?

Gained by circular remittance, £10 3s. $8\frac{1}{2}$d.

Arbitrated value of a piaster by ditto. $56\frac{1777}{2000}$.d

INSURANCE.

Rule. Place the value of the property insured and the rate per cent. on the *right* hand side of the line, and 100 on the *left* hand side.

1. Required the insurance on an East India ship and cargo valued at 124000 dollars at $12\frac{1}{2}$ per cent.

Solution. —2 —100 | 124,000— 15,500 dolls. Ans.
—4 | 5 —

2. Required the insurance on 72000 dollars at $4\frac{4}{5}$ per cent. Ans. $3456.

3. Required the insurance on the ship Constitution and cargo, valued at 144000 dollars at $6\frac{2}{3}$ per cent.
Ans. $9600.

4. Required the insurance on 4 buildings, each valued at 2800 dollars at $3\frac{1}{3}$ per cent. $373\frac{1}{3}$.

5. Required the insurance on the ship Elizabeth Ann, and cargo; the value of the ship being 80,000, and that of the cargo $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{6}{7}$ of the value of the ship at $4\frac{4}{5}$ per cent? Ans. $4320.

6. Required the insurance of the brig Hannah, and cargo, valued at $160,000 at $14\frac{2}{5}$ per cent?
Ans. $230 40.

COMMISSION.

Rule. Place the value of the property deposited, and the rate per cent. of the commission on the *right* hand side of the line, and 100 on the *left* hand side.

1. Required the commission on 800 dollars at 4 per cent.

Solution. —100 | 800— 8
4

$32 Ans.

2. A gentleman received goods to the value of 1200 dollars to be sold on commission at $3\frac{1}{3}$ per cent. Required his commission. Ans. $40.

3. Required what a factor may demand on $4\frac{1}{4}$ per cent. commission for laying out $848,50. Ans. $40 72,8.

4. Required my commission on $3\frac{4}{7}$ per cent. for $150 40.
Ans. $5 37$\frac{1}{7}$.

5. Received goods to the value of 9000 dollars at $2\frac{1}{2}$ per cent. Required my commission. Ans. $225.

6. A gentleman deposited in my care goods to the value of 17400 dollars, and allowed me $8\frac{1}{3}$ per cent. commission, with which I purchased other goods to the value of 1450 *dollars.* How much had I left? Ans. nothing.

DISCOUNT.

Rule. Place the sum on which the discount is to be made on the *right* hand side of the line, and the amount of one dollar for the given time and rate per cent on the *left* hand side, and the quotient will be the present worth. Subtract the present worth from the sum due, and you will obtain the discount.

1. What is the present worth of 600 dollars, due 4 years hence, at 5 per cent?

Solution.

100	—120	600—5
5		100
500		$500 Ans.
4		
2000		
100		
120		

2. What must be discounted for the ready payment of 100 dollars, due a year hence, at 6 per cent a year?

Ans. $5 66.

3. Bought goods amounting to $615 75, at 7 months credit; how much ready money must I pay, discount at 4½ per cent. per annum? Ans. $600.

4. What is the difference between the interest and discount on $600 for 12 years, at 5 per cent?

Ans. interest $360, discount $225, diff. $135.

5. What is the present worth of 672, due 2 years hence, discounting at the rate of 6 per cent. per annum?

Ans. £600.

EQUATION OF PAYMENTS.

Rule. Multiply each payment by the time which must elapse before it becomes due, and place the sum of the *products on* the *right* hand side of the line, and the sum *of the payments* on the *left* hand side.

1. A owes B $380, to be paid as follows, viz:—$100 in 6 months, $120 in 7 months, and $160 in 10 months; what is the equated time for the payment of the whole debt?

Solution.

100	6	600
120	7	740
160	10	1600
—380		3040—8 Ans. 8 months.

2. A merchant has owing him £300, to be paid as follows—£50 in 2 months, £100 in 5 months, and the rest in 8 months; and it is agreed to make one payment of the whole; I demand the equated time. Ans. 6 months.

3. F owes H $1000, whereof $200 is to be paid down, $400 in 5 months, and the rest in 15 months, but they agree to make one payment of the whole; when must that time be? Ans. 8 months.

4. A merchant has due to him a certain sum of money, to be paid one-sixth in 2 months, one-third in 3 months, and the rest in 6 months; what is the equated time for the payment of the whole? Ans. $4\frac{1}{3}$ months.

BARTER.

Rule. Place the several constituents of the commodity whose value is given on the right hand side of the line, and the constituents of those whose value is required on the left hand side.

Note. The principle involved in this rule is the same as that in the Rule of Three or Simple Proportion.

EXAMPLES.

1. A has 120 bushels of wheat, worth 80 cents per bushel, for which B gave him 60 bushels of corn, what was the corn per bushel?

	80	
—60	120—	2
	$1,60 Ans.	

2. G has 12 hhds. of molasses, each hhd. containing 120 gallons, valued at 40 cents per gallon, for which S gave him cloth valued at $4.80 per yard, how many yards of cloth will pay for the molasses?

—4,80 | 12—
120.
4—

| 120 yards. Ans.

3. How much wheat at $1,25 a bushel must be given in barter for 50 bushels of rye, at 70 cents per bushel?

50— 2
—5 —125 | 70— 14

| 28 bushels. Ans.

4. How much butter at 12½ cents a lb. must be given in exchange for 12 lbs. of indigo, at $2,25 per lb.?

12
—25 | 225— 9
2

| 216 lbs. Ans.

5. A has 4 tuns of wine worth 3 pence per pint, New York currency, he will barter with B. and take rye at 63 cents per bushel, how many bushels of rye will pay for the wine?

4—
2
2
63—
4—
2—
—12 | 3—
—8 | 100
—63

| 400 bushels. Ans.

6. B has 12 tons of iron at 4 pence per lb., (New York) for which C gave him wheat at $1,40 per bushel, how many bushels of wheat did C give for the iron?

	12—
	20—
	4—
	28— 2
—12	4
—8	100
—140	

800 bushels. Ans.

7. A has cloth that cost 28 cents, B has cloth that cost him 22 cents, and he puts it at 25 cents, how high must A put his to gain 10 per cent. more than B?

	28— 14— 7
—2 —22	25— 5
—2 —100	110—

35 cts. Ans.

8. B has C's note for $250 with 6 months interest due on it, and to redeem it, C delivers him 60 bushels of wheat at $1,25 per bushel, 50 bushels of corn at 87½ cents per bushel, and the balance in staves at $30 per thousand, what number of staves did B receive?

Ans. 5550 staves.

9. A has tea which he bartered with B at 10 pence per lb. more than it cost him, against cambric which stands B in 10 shillings per yard, but he puts it at 12s. 6d. I would know the first cost of the tea?

Ans. 3 shill. 4 pence per lb.

10. A has 240 bushels of rye, which cost him 90 cents per bushel, this he barters with B at 95 cents for wheat that stands B in 99 cents per bushel, how many bushels of wheat is he to receive in barter, and at what price is it to be rated, that their gains may be equal?

Ans. $218\frac{33}{209}$ bush. at $1,04½ per bush.

11. A and B barter some goods, A puts his at $30\frac{6}{25}$ shillings, and gains 8 per cent., B puts his at $24\frac{3}{10}$ shillings, and gains at the same rate. What was the first cost of *the goods?* Ans. 28 shillings and 22 shillings 6 pence.

12. How many bushels of wheat at 5 shillings per bushel must I give for 84 bushels of corn at 7 shillings 6 pence per bushel? Ans. 126 bushels.

13. A buys of B 4 puncheons of rum, containing 410 gallons, at $1,10 per gallon, and in return he pays him $112 cash, and the remainder in wheat, at $1,84 per bushel, how many bushels must A receive?

Ans. 184,239.

14. How much tea, at 7 shillings 6 pence per lb. must be given in barter for 234 yards of flannel, at 3 shillings 9 pence per yard? Ans. 117 lbs.

15. Sold goods to the value of $245, and received in payment 101 bushels of corn at 64 cents per bushel, the remainder is to be paid in wheat, at $1,12 per bushel, how many bushels will pay the balance? Ans. $161\frac{1}{28}$.

16. Sold 96 yards of cloth at 4 shillings 8 pence, New York currency, per yard, received in payment 72 gallons of whiskey at 3 shillings 9 pence, New England currency, per gallon, how many dollars will pay the balance?

Ans. $11.

17. A holds a note against B for $250, with 6 months interest thereon at 6 per cent., and to redeem it B delivers him 70 bushels of wheat at 7 shillings 6 pence, New York currency, per bushel, and 250 bushels of corn at 4 shillings 9 pence per bushel, how many dollars will pay the balance? Ans. $43,4375.

18. How many yards of carpeting at 78 cts per yard, cash price, must be given for 45 yards of broadcloth at $5,80 per yard, bartering price, when the cash price was only $4,90. Ans. $282\frac{1}{2}+$ yards.

19. A has 200 yards of cloth at 25 cents per yard ready cash, which he barters with B at 31 cents, taking sugar of him at 10 cents per lb., which is worth but 8 cents, who gets the best bargain?

Ans. B gets 40 cents the best bargain.

20. A has linen cloth at 30 cents per yard, ready cash, but in barter will have 36 cents; B has 1810 yards of ribbon at 22 cents per yard, ready cash, and would have $200 in present cash, and the rest in linen cloth. What price does the ribbon bear in barter per yard, and how much linen must A give B? Ans. The bartering price for the ribbon is 26 cts. 4 ms., B must receive $660\frac{3}{4}$ yards.

21. Suppose A has 350 yards of linen at 25 cents per yard, which he will barter with B for sugar at $5 per cwt., how much sugar will the linen come to?

Ans. 17½ cwt.

22. A and B barter, A has 3 cwt. 2 qrs. 14 lbs. of cheese at $6 per cwt., but in barter he will have $6½, B has butter worth 12 cents per lb., how must B sell his butter per lb. in order that he may sustain no loss? Ans. 13 cents.

23. How many lbs. of butter at B's bartering price will pay him for 2¼ cwt. of his cheese at the above rates?

Ans. 112½.

24. Two merchants, A and B, barter, A has 30 cwt. of iron at $5,40 per cwt., B has 12 pieces of broadcloth, each piece containing 16 yards at $4,05 per yard, how many yards of carpeting at $1,05 per yard will pay the balance?

Ans. 586⅔ yards.

25. A and B barter, A has 7 cwt. 3 qrs. 14 lbs. of cheese at $6 per cwt., but in barter he will have $6,72, B has satinett at $2 per yard, cash price, how must B sell his satinett in barter per yard to be equal to A's bartering price, and how many yards of satinett will pay for B's cheese? Ans. $2,24 B's bartering price, and 23 yards 2 qrs. 2 nails pays for his cheese.

PROFIT AND LOSS.

Rule. When it is required to know what is gained or lost per cent., ascertain what the gain or loss is by subtraction, then place 100 and the gain or loss on the RIGHT hand side of the line; and the price it cost on the LEFT hand side. When it is required to know how a commodity must be sold to gain or lose so much per cent., place the value of the commodity and 100 with the gain per cent., added, or loss per cent., subtracted on the RIGHT hand side of the line, and 100 on the LEFT. When there is gained or lost per cent., to ascertain what the commodity cost, place the price at which it is sold and 100 on the RIGHT hand side of the line, and 100 with the gain per cent. added or loss per cent. subtracted, on the LEFT hand side. When any commodity is sold at a given rate, and by which

so much can be gained or lost per cent., to know what would be gained or lost per cent., if sold at any other rate, place the FIRST price on the LEFT hand side of the line, and the other price with 100 and the profit per cent. added or loss per cent. subtracted on the RIGHT hand side of the line.

EXAMPLES.

1. A gentleman purchased wine at 80 cents per gallon, how must he sell it per gallon to gain 20 per cent?

	100		8,0—
Gain	20	1 —00	12,0—
	120		96 cts. Ans.

2. A merchant bought sugar at 10 cents per lb., but being damaged, he was content to lose 20 per cent.; how much must he sell it per lb.?

	100		1,0—
Loss	20	1 —00	8,0—
	80		8 cts. Ans.

3. Bought coffee at 12 cents per lb., and sold it at 16 cents per lb., what is the gain per cent?

Note. We will solve this example by two methods; in the first method, we subtract the cost price from the selling price, and then place the cost price on the left hand side, and the difference between the two prices, with 100 on the right hand side of the line. In the second method, we place the cost on the left, and the selling price with 100 on the right, the excess or deficiency of the 100 is the gain or loss per cent.

16	3 —12	100		3 —12	100		
12		4—			16— 4		
4	3	100=33⅓		3	400=133⅓—100=33⅓.		

4. If 9 yards of cloth cost 63 dollars, how must 45 yards be sold, to gain 40 per cent.?

	—9	45— 9
—2	—100	63— 7
		140— 7
		\$441 Ans.

5. If $4\frac{4}{5}$ yards of cloth cost $\$6\frac{6}{11}$, how must $\frac{3}{4}$ of $\frac{1}{9}$ of $\frac{6}{8}$ of $5\frac{1}{2}$ yards be sold to lose 12 per cent.?

	—4	3—
—3	—9	4—
4	—8	6— 3
	—2	11—
	—24	5—
	—11	72— 3—
5 —20	—100	88— 22— 11
20		33=$\$1\frac{13}{20}$, Ans.

6. If $\frac{4}{5}$ of $\frac{5}{8}$ of a yard of linen cost $\frac{7}{10}$ of $\frac{3}{7}$ of a £, New Jersey currency, for how many cents must $\frac{1}{4}$ of $\frac{4}{5}$ of a yard be sold to gain 25 per cent.?

	—4	1
	—5	4—
	—4	5—
	—5	8— 2—
—5	—10	7—
	—7	3—
N. J.	—3	8, 00— \$
	—100	125— 5
		40 cts. Ans.

7. If $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{6}{7}$ of $\frac{7}{12}$ of a yard of muslin cost $\frac{7}{10}$ of $\frac{3}{7}$ of $\frac{4}{5}$ of $\frac{8}{9}$ of a £ (New Jersey currency,) for how many cents must $\frac{9}{12}$ of $\frac{6}{8}$ of $\frac{5}{6}$ of $\frac{3}{10}$ of a yard be sold to gain 30 per cent.?

—12	9—
—8	6—
—6	5—
—10	3—
—4	5—
—5	8—
—6	7—
—7	12—
—10	7—
—7	3—
—8	4—
—9	8—
—3	800—
—100	130— 26

26 cts. Ans.

We will solve the above example, agreeable to the rules in common arithmetic.

First, We are required to reduce compound fractions to simple ones. Rule, Multiply all the numerators together for a new numerator, and all the denominators together for a new denominator; then reduce all of these to their lowest terms.

Reduce $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{6}{7}$ of $\frac{7}{12}$ to a simple fraction.

$$\frac{4}{5} \times \frac{5}{6} \times \frac{6}{7} \times \frac{7}{12} = \frac{840}{3360} = \frac{1}{4}$$

Reduce $\frac{7}{10}$ of $\frac{3}{7}$ of $\frac{4}{5}$ of $\frac{8}{9}$ to a simple fraction.

$$\frac{7}{10} \times \frac{3}{7} \times \frac{4}{5} \times \frac{8}{9} = \frac{672}{5040} = \frac{2}{15}$$

Reduce $\frac{9}{12}$ of $\frac{6}{8}$ of $\frac{5}{6}$ of $\frac{3}{10}$ to a simple fraction.

$$\frac{9}{12} \times \frac{6}{8} \times \frac{5}{6} \times \frac{3}{10} = \frac{810}{5760} = \frac{9}{64}$$

Then, if $\frac{1}{4}$ of a yard cost $\frac{2}{15}$ £, what will $\frac{9}{64}$ of a yard cost?

$\frac{4}{1} \times \frac{2}{15}$:x: $\frac{9}{64} = \frac{72}{960} = \frac{3}{40}$ of a £

$\frac{3}{40} \times \frac{20}{1} = \frac{60}{40} = 1\frac{1}{2}$ shill. 1—6×12=18

s. *d.* *s.* *d.* *d.* *d.*

7 6×12=90 $\frac{18}{90} = \frac{1}{5}$ of a $

cts. *cts.*

100×$\frac{1}{5}$=20

100 : 20 : : 130

130

1,00)26,00

26 Ans. as before.

8. A gentleman purchased a cask of wine, containing 220 gallons, at 75 cents per gallon; he allows his agent 10 per cent. commission for purchasing, and pays in gold, for which he is allowed a premium of 4 per cent., and by accident, 20 gallons leak out: how must the remainder be sold per gallon, to gain 20 per cent.?

	220— 2—
	75— 3
—110	100—
—100	104— 26
5 —200	
—4 —100	120— 6

5 | 468=cts. 93$\frac{3}{5}$ Ans.

9. Bought 90 gallons of wine, at $1,20 per gallon, but by accident 10 gallons leaked out; at what rate must I sell the remainder per gallon, to gain upon the whole prime cost at the rate of 12 $\frac{1}{2}$ per cent.? Ans. $1,51,8+.

10. By selling broadcloth at three dollars twenty-five cents per yard I lose at the rate of twenty per cent.; what is the cost of the cloth per yard?

Ans. $4 06,25.

11. If forty pounds of chocolate be sold at twenty-five cts. per pound, and I gain nine per cent., what did the whole *cost me*? Ans. $9 17,4+.

12. If I sell cloth at 5s per yard, and thereby gain fifteen per cent., what shall I gain per cent. if I sell it at 6s per yard? Ans. 38 per cent.

13. If I retail oil at one dollar fifty cts. per gallon, and thereby gain twenty-five per cent., what shall I gain or lose per cent., if I sell it at one dollar eight cents per gallon? Ans. lose 10 per cent.

14. If I sell one hundred pounds of sugar for eight dollars, and thereby lose twelve per cent., what shall I gain or lose per cent, if I sell four hundred pounds of the same sugar for thirty-six dollars? Ans. lose 1 per cent.

15. A man sold a horse for one hundred and twenty dollars, and thereby lost twenty per cent., whereas he ought to have gained thirty per cent.; how much was he sold under his real value? Ans. $75.

16. If I buy six cwt. of sugar at ten pence N. Y. currency per lb., and am allowed four per cent. discount for ready money, and sell the same so as to gain fifteen per cent. on the money advanced, how much money do I receive? Ans. $77,28.

17. Bought twelve chests of tea, each weighing fifty-six pounds, at four shillings and six pence N. E. currency per pound: for ready money was allowed two per cent. discount; how much must I receive for the whole to realize a profit of 10 per cent. on the cash paid out?

Ans. $543,312

18. How must cloth which costs thirteen shillings and four pence be sold to gain $12\frac{1}{2}$ per cent.?

Ans. 16 shillings per yard.

19. Bought 1250 barrels of flour for $6250, at what price per barrel must I sell it to gain $12\frac{1}{2}$ per cent.?

Ans. $5,62\frac{1}{2}$.

20. Bought thirty hogsheads of molasses at $20 per hogshead, in Havana; paid duties $20,66, freight $40,78, portage $6,05, insurance $30,84; what per cent. should I gain by selling at $26 per hogshead? Ans. $11\frac{695}{1000}+$.

21. Bought wheat at seventy-five cents per bushel; at what rate must I sell it to gain twenty per cent.?

Ans. 90 cts.

22. If I purchase thirteen cwt. of coffee at $12\frac{1}{2}$ cents *per pound*, at what price per pound must I sell it to gain *$80,80 on the whole*? Ans. 18 cts.

23. A miller sold a quantity of rye at $1 per bushel and gained twenty per cent.; soon after, he sold of the same to the amount of $37,50 and gained fifty per cent.; how many bushels were there in the last parcel, and at what did he sell it per bushel? Ans. 30 bushels, at $1,25.

24. A trader bought one hogshead of gin, of a certain proof, containing 115 gallons, at $1,10 per gallon; how many gallons of water must he put into it to gain $5, by selling it at $1 per gallon? Ans. $16\frac{1}{2}$ gallons.

25. Bought four hogsheads of wine, containing 450 gallons, at $1 per gallon, and sold it at $1,20 per gallon, and gave 3 months' credit; allowing the leakage of the wine while in my possession to be ten gallons, I would know the gain or loss, discounting for the present worth of the debt, at six per cent. per annum. Ans. $70,19 gain.

26. A vinter buys 596 gallons of wine, at 6 shillings 3 pence per gallon, in ready money, and sells it immediately at 6 shillings 9 pence per gallon, payable in 3 months; how much is his gain or loss, supposing he allows the interest for the time at 6 per cent. per annum as discount for present payment? Ans. gain £11 17s. 8d.

27. What would be the gain or loss on the aforesaid wine, supposing the discount for present payment to be made at 2 per cent., without any regard to time?

Ans. gain £10 17s. $6\frac{1}{2}$.

28. A merchant bought a parcel of cloth at the rate of $1, for every 2 yards of which he sold a certain quantity at the rate of $3, for every 5 yards, and then found he had gained as much as 18 yards cost; how many yards did he sell? Ans. 90 yards.

29. A distiller is about purchasing 10,000 gallons of molasses, which he can have at 48 cents per gallon in ready money, or fifty cents per gallon with 2 months' credit. It is required to know which is more advantageous to him, either to buy it on credit, or to borrow the money at 8 per cent. per annum, to pay the cash price.

Ans. he will gain $136 by paying cash.

TARE AND TRET.

Tare and Tret allowances made in selling goods by weight.

Draft is an allowance on the gross weight in favor of the buyer or importer; it is always deducted before the tare.

Tare is an allowance made to the buyer for the weight of the hogshead, barrel or box or bag, &c., containing the commodity.

Gross weight is the whole weight of the goods, together with the hogshead, barrel, or bag that contains them.

Suttle is when part of the allowances is deducted from the gross.

Net weight is what remains after all allowances are made.

Tret is an allowance of 4 pounds for every 104 pounds, made for the dust, &c.

Rule. Place the whole gross weight first on the right hand side of the line, then place 112 lb =cwt. on the left hand side, with 112 diminished by the tare per cwt. standing directly opposite on the right.

EXAMPLES.

1. What is the net weight of 44 cwt. gross, if 14 lbs. per cwt. be allowed for tare?

—112	44— 11
2 —28	98— 7
2	77=38½ cwt. Ans.

2. Bought 84 cwt. of sugar; what is the net weight, if 20 lbs. per cwt. be allowed for tare?

—4 —16 —112	84— 12— 3
	92— 23
	69 cwt. Ans.

3. Bought 7 hogsheads of sugar, each weighing 8 cwt. 2 qrs.; from this a deduction of 16 lbs. per cwt. was made for tare; what was the net weight?

		7—			$8\frac{1}{2}$
	—2	17			17
—16	—112	96—	48—	3	—
					2

51 cwt. Ans.

4. What is the value of 8 hogsheads of sugar, each weighing 12 cwt., gr. tare, 12 lbs. per cwt. at $8,40 per cwt.?

		8—	
		12	
—14	—112	100	
		840—	60

$720

5. Bought 15 cwt. of sugar, at $6,50 per cwt, net weight, reduction for tare 12 lbs. per cwt., tret 4 lbs. per 104 lbs.; how must I sell the whole to gain 20 per cent. on the first cost?

			15		
			650—	325	
7	—28	—112	100—	25	
26	—52	—104	100—		
		—100	120—	30—	15

182 | 182 8125 = $100,44+ Ans.

6. Bought 742 lbs. gro. weight of cotton, and was allowed a deduction of 5 per cent. for tret, and for the net weight I paid 9 shillings (N. J. currency) per lb., and was allowed a deduction of 6 per cent. on the whole cost for ready money, I then sold the same so as to realize a profit of 20 per cent. on the cash I advanced; how much did I receive for the whole?

—5	—15	—105	742—	7—	
			100—	2—	0
		—20	9—	3—	
		—3	8		
		—106	100—		
		—100	12	—0	

$960 Ans.

7. A tobacconist buys 4 hogsheads of tobacco, weighing 38 cwt. 2 qrs. 8 lbs., gross, tare 94 lbs. per hogshead, at $9 per cwt., ready money, and sells it at 11½ pence per lb., allowing tare at 14 lbs. per cwt., to receive ⅔ in cash, and for the remainder a note at 90 days' credit; his gain or loss is required, supposing the interest for the time at 6 per cent. per 360 days is allowed for discount, on turning the note into cash. Ans. $283,80 gain.

8. Bought 32 casks of figs, each weighing 2 cwt. 2 qrs. at a deduction of 18 lbs. per cwt. for tare, what did the whole cost me, at $4 per cwt. net weight?

Ans. $268,57.

9. Bought 32 chests of tea, each weighing 4 cwt. 2 qrs. at $49 per cwt. net weight, tare 12 lbs. per cwt., tret 4 lbs. per 104 lbs., how must I sell the whole quantity to gain 20 per cent.? Ans. $7269 23.

10. Bought 5 cwt. of sugar, tare allowed 8 lbs. per cwt., for the net weight I paid 6 pence (N. Y. currency) per pound; how must I sell the whole quantity to gain 20 per cent.? Ans. $39.

11. Purchased 12 bags of coffee, each weighing 96 lbs., tare per bag 6 lbs., what was the whole cost at 30 cents per lb., and the retail price to gain 25 per cent.?

Ans. Cost $324, retail price 37½ cts.

12. How much will 8 hogsheads of sugar, each weighing 8 cwt. 3 qrs, cost at $9 per cwt., if a deduction of 12 lbs. per cwt. be allowed for tare, and what will be received for the whole, if it be sold at an advance of 30 per cent.?

Ans. Cost $562,50, received $731,25.

13. What is the net weight of 3 tierces of rice, each weighing 4 cwt. 3 qrs. gross, tare 16 lb. per cwt., tret 4 lbs. per 104 lbs. Ans. 11 cwt. 2 qrs. 27 lbs.+.

14. Purchased in London 16 cwt. of tea, at £28 sterling per cwt., net weight, tare 12 lbs. per cwt., how much must I receive, in federal money, for the whole quantity, to realize a profit of 12 per cent., and what retail price will allow the same profit?

Ans. Wholesale $1991,11, retail $1,24.

15. Bought 16 firkins of butter, each weighing 108 *lbs, reduction* for tare 8 lb. per cwt., paid 15 pence New

England currency per lb., what did it cost me, and what must be the wholesale and retail price, to gain 20 per cent. on the first cost?

Ans. Cost $334,28+wholesale $401,14+retail $0 25.

COMMERCIAL EXCHANGE.

Under this rule are included the operations of purchasing goods in one country and selling them in the currency of another country, so as to gain or lose some required per cent.

Rule. Place the whole cost in the given currency, first on the right hand side of the line, (if the retail price be required) the number expressing the quantity procured for that price first on the left hand side, write next on the right the value of a unit of the given currency, in federal money, and lastly to increase or diminish the price by the required per cent; place 100 on the left of the line, and 100 increased by the per cent. to be gained, or diminished by the per cent. to be lost on the right hand side of the line.

Note. If the wholesale price be required, the number expressing the whole quantity (by the preceding rule placed on the left of the line) must be rejected.

EXAMPLES.

1. Purchased in London 360 yards of broadcloth, which cost me, including transportation, £300, sterling, how must I sell the same per yard, in federal money, to make a profit of 20 per cent.?

			300—	
	—3	—360		
£		9	40	$
	1	—00	120—	
		9	40=$4,444	Ans.

2. Purchased in London 350 yards of sheeting, for £75, and paid £12 for its transportation to New York; how must I retail the same, in federal money, to gain 15 per cent. on the first cost?

	87
7 —350	
9	40—
25 —100	115— 23
1575	2001 = $1,27+ Ans.

3. A merchant in London bought 700 ells of cloth, at 5 shillings sterling per ell, the cost of transportation and duty of the whole amount was 35 per cent., the exchange at par or 4½ shillings on the dollar; for how many cents must one yard be sold in Philadelphia, to gain 12½ per cent?

	1	
Yards. —5	4—	English ells.
—9	5—	
	2—	
—100	100—	
	135	
—4 —100	225— 25—	
—2		
	$1,35 Ans.	

Note. A merchant who is not acquainted with this system of arithmetic, proceeds by the circumstantial calculation of the rule of three, or by fractions; and to find the answer required in this question, he is obliged to make six statements before he is able to find the answer.

As proof, we will go through the calculation of the six statements by the rule of three:

1st Question. How many £s sterling will 700 ells of cloth cost, at 5 shillings per ell?

ell	*shill.*
1 :	5 : : 700
	700
2(0)350(0	
£175	

2d. Question. How much will £175 gain at thirty-five per cent ?

£ £ £
100 : 135 :: 175
175

675
945
135

1,00)236,25

236¼

3d Question. In 236¼ pounds, how many $s at 4½ shillings each ?

shill. $ £
4,50 : 1 :: 236,25
20 shillings.

450) 472500(1050
450

2250
2250

0

4th Question. How much will $1050 amount to at 12½ per cent gain ?

$ $ $
100 : 112,50 :: 1050
1050

562500
11250

1,00)1181,25,00

1181¼

5th Question. In 700 ells how many yards?

ells. yds. ells.
4 5 700
700

4)3500

875 yds.

6th Question. If 875 yards cost $1181,25, how many cents will one yard cost?

yds. $ *yd.*
875 : 1181,25 : : 1
1

875)1181 25(1,35 as before.
875

3062
2625

4375
4375

3. Received from England 3 hhds. of wine at 10 pence sterling per pint, for which I paid for freight and duty 25 per cent., exchange being 10 per cent. premium. How many dollars will 3 hhds. cost in Penn.?

	3---
	63--- 7
	4---
	2---
---12	10---
---20	
---9	40---
---100	125--- 5
---4 ---100	11 0---
	$385 Ans.

4. If a merchant of New York has to pay in England the sum of £783 at 10 per cent. premium, he must send $3828 or pay the same to a broker to obtain a draft for it, if New York funds are 6 per cent better than those of Philadelphia, and that a Philadelphia merchant had received the same merchandise from England, how much must he pay the broker?

	783--- 87
---9	40---
1 ---00	11 0—
25 ---100	106

25 | 101442=$4057 68 Ans.

New York merchant pays 3828

229,68 diff.

5. A merchant had 18000 lbs. of wool, which he could sell at 9 pence, New England currency per lb., but not finding a purchaser to suit him he bartered with A and gave 7½ lbs. of wool for two yards linen, not yet finding a cash customer, he bartered his linen with B for sugar, and gave 2½ yards of linen for 3½ lbs. of sugar, and changed his sugar with an Englishman for broadcloth, and gave 1 cwt. of sugar for 20 ells of broadcloth. Now he sold his cloth for $2 per yard, what did he lose or gain by this transaction, estimating the wool 9 pence (New England currency) per lb.

	18000—2250	---3 ---15	18000--- 1500
---4 ---12	9--- 3---		2---
---20		---5	2---
---3	10---		2---
		---2	7---
First offer	$2250	---112	20--- 2
		---4	5---
			2---
	$3000		
	2250		$3000 Ans.

750 difference, gain.

6. A gentleman of the United States left his 7 children a piece of land 6 miles long, $4\frac{3}{4}$ miles broad. A son settled in England, sold his part there for £$4\frac{1}{2}$ sterling per acre, but being indebted to his relations he sent the money to the United States, exchange at that time 5 per cent premium. For what ought the bill to draw?

---7	1
	6--- 3
---4	19
	64 0---
---2	9---
---9	40---
---100	105--- 15

$54720. Ans.

7. A Frenchman had failed in trade by misfortune, but his father being wealthy resolved to establish him again in the United States, and furnished part of the cargo of a vessel, and took passage with his son in her; two sons of the father remained in France, also three children of his son, but two of them, brother and sister, had taken passage in a packet ship. The vessel with father and son was lost at sea. The cargo was insured for 1,347,840 francs, of which the grandfather possessed $\frac{1}{12}$ part. By chance a young clerk became acquainted with the brother and sister, his principal being appointed commissioner from the different partners of the insurance to settle the business in France, allowing him 4 per cent. commission. The clerk and brother having become intimate friends, he proposed to marry his sister, and to commence business for themselves by selling their parts of the insurance to said commissioners, at a discount of ten per cent, and as they agreed so, the question is, with how much federal money did the brothers-in-law begin business, if exchange at that time was $10\frac{1}{2}$ pence sterling per franc, and from England to America 10 per cent. premium?

[Solution next page.]

—5	2—
3—	1
—3 —12	1
	1347840— 149760—
—2	21— 7 24960—
—6 —12	8320—
—20	80
—9	40—
—100	110—
—110	100—
104—	100— 5

$2800. Ans.

8. A merchant imported from England 975 ells of cloth at 7 shillings 6 pence per ell. The commission and duty amounted to 40 per cent., exchange 10 per cent. premium, how must 1 yard be sold in the United States to gain 12½ per cent?

For the proof state the example as before, then place the answer on the left, and if all the numbers cancel, the work is right, thus:

---11 —231		---5	4---
---5	4---	---2	15--- 3---
---2	15--- 3---	---3 ---9	2---
---9	2---	---100	100---
---100	100—		140--- 7
	140--- 7—	---100	11 0—
---100	110--- —4	—100	225— 75— 3
---25 —100	225— 9—	—2	
—2			

$2,31

9. Received from London 470 yards of linen, which, including transportation, cost me £65, sold the same by the yard so as to gain 30 per cent. on the first cost, how did I sell it? Ans. $,79+.

10. Received from Dublin 600 yards of Irish linen, the whole cost of which was £75 Irish currency, how must I retail the same in federal money to gain 12½ per cent?

Ans. $0,576 per yard.

11. Received from my agent in Dublin 900 yards of linen, whole cost £60 Irish currency, how must I retail the same in federal money to gain 15 per cent?

Ans. $0,31,4+.

12. I have in my store 120 yards of broadcloth forwarded me by my agent in Paris, which cost me including transportation 325 crowns, how must I sell the same in federal money, to gain 16 per cent.?

Ans. $3,455+ per yard.

13. Received from Madrid 6 hhds. of wine, each containing 63 gallons, for which my agent paid 188 Spanish dollars, how must I sell the same per gallon to gain 12½ per cent? Ans. $0,559+.

14. I have on hand a bale of silk containing 174 yards, which I received from Cadiz, at a cost, including transportation, of 140 piasters or Spanish dollars, how must I sell the same per yard to gain 5 per cent.?

Ans. $0,844.

15. Received from Oporto 3 hhds. of port wine, containing 63 gallons each, cost including transportation, 30 milrees per hhd., how must I retail the same per gallon to gain 25 per cent.? Ans. $0,738+.

16. Consigned to my agent, J. Smith, of London, 300 barrels of flour, for which I paid $1500. How many £'s sterling ought he to receive for the same to gain 10 per cent., the expense of transportation being $50.

Ans. £383 12 shillings 6 pence.

17. Received of my agent in London, J. Smith, 2510 gallons of Madeira wine, which cost me per invoice £1640 sterling, but it being of an inferior quality I am willing to lose 5 per cent. on the cost, what must be the price per gallon in federal money? Ans. $2,758+.

18. Three men traded in company, received from France 1200 bottles of champagne, for which they paid 600 French guineas, each $4,60, how must they sell the same per bottle in federal money to gain 40 per cent., and what will be each man's gain per bottle?

Ans. $3,22 each man's gain, $0, 306+.

19. Received 300 ells of cloth from Hamburgh, which cost me 1500 mark bancos, how must the same be sold in *federal money* by the yard to gain 12½ per cent, the ell of *Hamburgh* being 2½ qrs. Ans. $1,17+.

20. NEW YORK, June 9th, 1840. This day, received from Amsterdam 600 yards of carpeting, whole cost 2400 guilders, required the retail price in federal money to gain 20 per cent? Ans. $1,92.

21. Shipped to London 380 barrels of flour, which cost me, including transportation, $6 per barrel, how many English crowns must I receive for the whole quantity to gain 10 per cent? Ans. 2280 crowns.

TABLE OF UNCOINED AND SILVER MONEY.

ENGLISH CURRENCY.

£1 sterling (before 1832)	equalled	$4,44
£1 " (since 1832)	"	4,80
Or prior to 1832 £9	"	40,00
Since 1832 £5	equals	24,00
1 English crown	"	1,10
or 10 English crowns	"	11,00
1 English shilling	"	,22$\frac{1}{2}$
1 pistoreen	"	20
1 English penny	"	,01$\frac{85}{100}$

IRISH CURRENCY.

£1 Irish	equals	$4,10
or £10	"	41,00
1 shilling	"	,20$\frac{1}{2}$
1 penny	"	,01$\frac{7}{10}$

FRENCH CURRENCY.

1 French Crown	equals	$1,10
or 10 crowns	"	11,00
1 five franc piece	"	,93
1 franc	"	,18$\frac{2}{5}$
1 Decimes	"	01,$\frac{86}{100}$

SPANISH CURRENCY.

1 Spanish dollar	equals	$1,00
1 real newplate	"	,10
1 real vellon	"	,06

CURRENCIES OF OTHER NATIONS.

1 millree of Portugal	equals	$1,24
1 Russian silver ruble	"	75
1 rix dollar of Sweden	"	1,00
1 Russian rix dollar	"	,66⅔
or three rix dollars	"	2,00
1 Danish rigsbank dollar	"	,50
1 silver ducat of Naples	"	,80
or 5 ducats	"	4,00
1 scudo of Sicily	"	,96
1 oncia of Sicily	"	2,40
1 pizza of Leghorn	"	,90
1 pizza of Genoa	"	,89
1 florin of Trieste	"	,48
1 Rix dollar of Trieste	"	,96
1 Roman Crown	"	1,00
1 gold Crown of Rome	"	1,53
1 Maltese scudo	"	,40
1 rupee of Bengal	"	,55½
1 rupee of Bombay	"	,50
1 pagoda of Madrass	"	1,80
1 tale of Canton	"	1,48
1 Japanese tale	"	,75
1 dollar of Sumatra	"	1,10
1 tale of Sumatra	"	4,16
1 florin of Java	"	,40
1 mark banco of Hamburgh	"	,33 3/10
1 guilder of Amsterdam	"	,40

SINGLE FELLOWSHIP.

Rule. Place the amount which each partner put in on the left hand side of the line, and the whole gain or loss, together with the stock each partner put in severally, on the right hand side.

EXAMPLES.

Three gentlemen, A, B and C, shipped a number of *horses to the* West Indies, of which A owned 24, B 36, *and C 48, and* in distress of weather the seamen were

obliged to throw 45 overboard, what part of the loss does each sustain.

A owned 24
B " 36 Whole loss 45.
C " 48

Whole stock 108

—9	—108	24—	2	—3	36—		—9	48—	4
		45—	5	—108	45—	15	—108	45—	5
		10 A's.			15 B's.			20 C's.	

20
15
10

45 proof.

A, B and C entered into partnership, A invested $400, B $600, and C $1000, and they gained $800, what is each ones share of the gain.

400
600
1000

2000

—5	—2000	400—		—2000	600—	3	—2000	1000—	
		800—			80	—0		$800—	400
		$160 A's.			$240 B's.			$400 C's.	

3. Two persons hired a coach in Boston to go 40 miles for $20, with liberty to take in two more when they pleased. When they had gone 15 miles they admit C who wished to go the same route and return with them to Boston, and on their return, within 25 miles of Boston, they admit D for the remainder of the journey. As each person is to pay in proportion to the distance he rode, it is required to settle the coach hire between them.

A 80
B 80
C 65
D 25

250 whole distance.

5	—250	8 0—	5	—250	8 0—
		20— 4			20— 4
5		32=6\frac{2}{5}$	5		32=6\frac{2}{5}$
5	—250	65— 13		—250	25—
		2 —0			2 0—
5		26=5\frac{1}{5}$			$2

A's $6\frac{2}{5}$
B's $6\frac{2}{5}$
C's $5\frac{1}{5}$
D's 2

$20

4. A gentleman distributed $60 among 4 of his servants, giving to A $\frac{1}{3}$, to B $\frac{1}{4}$, to C $\frac{1}{5}$, and to D $\frac{1}{6}$, what is each ones share?

$\frac{1}{3}$ of 60=20
$\frac{1}{4}$ " 60=15
$\frac{1}{5}$ " 60=12
$\frac{1}{6}$ " 60=10

57

		20			15
—57			19	—57	
19		60— 20			60— 20
19		400=21\frac{1}{19}$	19		300=15\frac{15}{19}$.
19	—57	12	19	—57	10
		60— 20			60— 20
19		240=12\frac{12}{19}$.	19		200=10\frac{10}{19}$.

A's $21\frac{1}{19}$
B's $15\frac{15}{19}$
C $12\frac{12}{19}$
D $10\frac{10}{19}$

$60 proof.

5. Six gentlemen, A, B, C, D, E and F entered into partnership for one year; A put in two hundred dollars, B three hundred, C four hundred, D five hundred, E six hundred, F eight hundred, and they gained five hundred and sixty dollars; what was each one's share of the gain?

Ans. A's share 40 dolls.; B's 60, C's 80, D's 100, E's 120 and F's 160.

6. Divide the number 360 into three parts which shall be to each other as 2, 3 and 4. Ans. 80, 120 and 160.

7. Two merchants have gained £450, of which A is to have three times as much as B; how much is each to have? Ans. A's share £337 10s., B's £112 10s.

8. Three persons are to share £600; A is to have a certain sum, B as much again as A, and C three times as much as B; what is each part?

Ans. A's £66⅔, B's £133⅓, and C's £400.

COMPOUND FELLOWSHIP.

Rule. Multiply each man's stock by the time during which he continued in trade, then place the amount of the several products on the left hand side of the line, and the gain or loss, together with the product of the stock of each of the partners, severally multiplied by the time, on the right hand side.

EXAMPLES.

1. A, B, and C hold a pasture in common, for which they pay $56. In this pasture A has 40 sheep for 6 weeks, B 60 sheep for 8 weeks, and C 80 sheep for 12 weeks. What part of the $56 ought each to pay?

A 40X 6=240
B 60X 8=480
C 80X12=960

1680 whole stock.

[Solution opposite page.]

	240— 8			480— 16	
—3 —1680	56—	—3 —1680		56—	
	$8 A's.			$16 B's.	
	8				
	16			960— 32	
	32	—3 —1680		56—	
	$56 proof.			$32 C's.	

2. Three merchants entered into partnership; A put in 200 dollars for two months, B put in 400 for three months, and C put in 200 for 7 months; they gained 600 dollars; what is each's share?

Ans. A's share $80, B's 240, C's 280.

3. A, B, C, D, E, F, G and H entered into partnership; A's stock was three hundred dollars for four months, B's four hundred for six months, C's five hundred for eight months, D's six hundred for five months, E's eight hundred for three months, F's two hundred for five months, G's five hundred for two months, and H's one thousand for five months; they gained nine hundred and sixty dollars; required each one's share of the gain.

4. Two merchants traded in company, A put in 215 dollars for 6 months, and B 390 dollars for 9 months, but by misfortune they lose two hundred, how must they share the loss? Ans. A's $53,75, B's $146, 25.

5. Three persons had received 665 dollars interest; A put in four thousand dollars for 12 months, B three thousand for 15 months, and C five thousand for 8 months; how much is each man's part of the interest?

Ans. A's $240, B's 225, C's 200.

6. A and B companied; A put in two thousand dollars Jan. 1, but B put in his share June 1; what did he then put in to have an equal share in the profits with A?

Ans. 3428\frac{4}{7}$.

7. Three merchants traded in company; A put in one hundred and twenty dollars for ten months, B one hundred for 18 months, and C one hundred fifty for 5 months;

they gained one hundred dollars; what was each man's share? Ans. A's $32, B's 48, C's 20.

8. E and S enter into partnership for 1 year; E first advances four hundred eighty dollars and B puts in his share 3 months after; how much must he advance to be entitled to an equal share of the gain at the expiration of one year? Ans. $640.

9. Two merchants trading in company gain two hundred dollars; A's stock was two hundred and twenty dollars for 6 months, and B's 380 dollars for nine months; how ought they to share the gain?

Ans. A's part $55,69,6, B's $144, 30, 4.

10. Two men commenced trading in company Jan. 1, 1841; A advanced one thousand dollars, at the time specified, but B did not advance his share till the first of May following; at the end of the year they shared the profits equally; what capital did B advance?

Ans. $1500

MENSURATION

OR

PRACTICAL GEOMETRY.

BOARD AND TIMBER MEASURE.

Rule. For measuring boards, place the length in feet and width in inches on the right hand side of the line, and 12 on the left hand side. But for square timber, place the length in feet and the width and thickness in inches on the right hand side of the line, and 12 for board measure or 144 for cubic feet on the left of the line.

EXAMPLES.

1. How many feet in a board 48 feet long and 13 inches wide?

	48— 4
—12	13
	52 feet Ans.

2. How many feet in a board 40 feet long and 27 inches wide?

	4— 0
—3 —12	27— 9
	90 feet. Ans.

3. How many feet in a board $6\frac{6}{11}$ feet long and 33 inches wide?

—11	72— 6
—12	33— 3
	18 feet. Ans.

4. How many feet in a board or plank $4\frac{4}{5}$ feet long and $7\frac{1}{2}$ inches wide?

—5	24—
—2	15— 3
—12	
	3 feet. Ans.

5. How many feet of boards in a square stick of timber (making no allowance for the saw) 60 feet long 7 inches wide and 6 inches thick?

	60— 5
—12	7
	6
	210 feet. Ans.

6. How many feet of boards in a square stick of timber 75 feet long, 18 inches wide and 8 inches thick?

	75
—2 12—	18— 3
	8— 4
	900 feet. Ans.

7. How many cubic feet in a stick of square timber 96 feet long, 24 inches thick, and 37 inches wide?

—6 —144	96— 16
	24—
	37

592 feet. Ans.

8. How many cubic feet in a square marble pillar $14\frac{2}{3}$ feet long, 15 inches wide, and 8 inches thick?

—5	72—
—2 —144	15— 3
	8— 4

12 cubic feet. Ans.

9. How many cubic feet in a stone or stick of timber 108 feet long, $4\frac{4}{5}$ inches wide and $3\frac{1}{3}$ inches thick?

---6 ---144	108--- 6
---5	24---
---3	10--- 2

12 cubic feet. Ans.

10. What is the content of a piece of timber 40 feet and the sides 18 by 21 inches? Ans. 105 feet.

11. What is the content of a piece of timber 48 feet long, and the sides 14 by 9 inches?

	48---
---3 ---144	14
	9--- 3

42 cubic feet. Ans.

12. What is the content of a piece of timber 9 feet long and the sides 32 by 7 inches? Ans. 14 feet.

13. How many cubic feet in a stone 20 feet long, 36 inches wide, and 4 inches thick?

Ans. 20 feet.

To find the solidity of a cylinder.

Rule. Place the square of the diameter, the decimal, 7854* and altitude, on the right hand side of the line, and the denomination next inferior to the answer on the left.

EXAMPLES.

1. Required the solidity of a cylinder the diameter 36 inches, and the length 20 feet.

	36---
	36
---4 ---144	,7854
	20--- 5
	141, 372 feet. Ans.

2. Required the solidity of a cylinder, the diameter being 4½ inches, and length 50 feet?

---5	24--- 4
---5	24---
---6 ---144	,7854
	50--- 2
	6,2832 feet. Ans.

3. Required the solidity of a cylinder the diameter being 9 inches, and altitude 12 feet. Ans. 5, 3014.

4. Required the solid feet contained in a stick of timber of equal thickness, the diameter being 9 inches, and length 24 feet. Ans. 10, 6029.

5. Required the cubic feet contained in a round stick of timber of equal bigness from end to end, the diameter being 18 inches, and length 36 feet. Ans. 63, 6174.

To square round timber.

Rule. Place twice the square of the semi diameter, together with the length on the right hand side of the line, and the denomination next inferior to that in which you wish your answer on the left.

* As the area of a circle whose diameter is 1 inch, is, ,7854 decimal parts of an inch.

EXAMPLES.

1. What will be the solid feet of a round stick of timber 24 inches diameter and 40 feet long, when hewn square?

---144	12--- 12--- 2 40
	80 feet. Ans.

NOTE. The square of a number is that number multiplied by itself.

2. What will be the solid content of a round stick of timber when hewn square, of $4\frac{4}{5}$ inches diameter and 75 feet long?

---6 ---144	---5 | 24--- 4 ---5 | 24--- 2 75--- 3
	24 feet. Ans.

3. What will be the solid content of a round stick of timber, when hewn square, of 5 feet diameter and 48 feet long?

---3 ---144	60 60--- 20 2 48---
	2400 feet. Ans.

GAUGING.

To find the number of gallons contained in a circular cistern.

Rule. Place the square of the diameter, the length, and 47 on the right hand side of the line, and 8 on the left, for gallons.

EXAMPLES.

1. Required the number of gallons in a circular cistern, the diameter being 8 feet and height 12 feet?

	8---
	8
---8	12
	47
	4512. Ans.

2. Required the number of hhds. in a circular cistern 16 feet diameter, and 20 feet deep, allowing the hhd. to contain 160 gallons.

	16--- 2
---8	16---
---160	2 0---
	47
	188 hhds. Ans.

3. Required the number of hhds. in a circular cistern $4\frac{4}{5}$ feet diameter, and $33\frac{1}{3}$ feet deep, allowing the hhds. to contain 141 gallons?

---5	24--- 8
---5	24---
---3	100--- 4
---8	47---
---3 ---141	
	32 Ans.

4. Required the number of gallons contained in a circular cistern, the diameter being 8 feet and the depth 4 feet?
Ans. 1504.

5. Required the number of gallons contained in a circular cistern of 12 feet diameter and 9 feet in depth?
Ans. 7614.

6. Required the number of gallons contained in a *circular cistern*, the radius being 8 feet and height 10 feet?
Ans. 15040.

NOTE. An ale gallon contains 282 cubic inches.

A wine gallon - -	231
A bushel - - -	2150
A cubic foot - - -	1728

The ale gallon is to the wine gallon as 58 to 71 nearly.

To find the contents of a cask.

Rule. To twice the square of the bulge diameter add once the square of the head diameter, and place this sum on the right hand side of the line, together with the length of the cask, then place 1077 for beer or 882 for wine on the left hand side.

EXAMPLES.

1. What is the content of a cask whose bulge diameter is 40 inches, the head diameter 30 inches, and the length, 60 inches, in wine measure?

	40	30
	40	30
	1600	900
	2	
	3200	
	900	
	4100	
—882	60— 2— 0	
147 —294		
147	41000=278$\frac{134}{147}$ galls. Ans.	

2. What is the content of a cask in beer gallon whose bulge diameter is 50 inches, the head diameter 36 inches, and length 90 inches?

[Solution, next page.]

50
50 36
36
2500
2 216
108
5000
1296 1296

6296
—1077 | 90— 30
359

359 | 188880=526$\frac{46}{359}$ galls. Ans.

To find the contents of a figure that has six sides, and the opposite sides parallel.

Rule. Place the length, breadth and depth on the right hand side of the line, then place on the left 2150 for bushels, or 282 for ale gallons, or 231 for wine gallons, or 1728 for solid feet.

EXAMPLES.

1. How many bushels of wheat will a box contain of the following dimensions; 86 inches long, 71 inches deep, and 25 inches wide?

—86 —2150 | 86—
71
25—

| 71 bushels, Ans.

2. How many bushels of corn will a box of the following dimensions contain; 645 inches long, 55 inches deep, and 22 inches wide?

—2 | 645— 3
—2150 | 55— 11
22— 11

| 363 bush. Ans.

3. How many bushels of rye will a box contain; $33\frac{1}{3}$ inches long, $17\frac{2}{10}$ inches wide, and $6\frac{1}{4}$ inches deep?

3	100— 5
1 —0·	172— 2
—2 —4	25—
—86 —2150	

3 | 5=$1\frac{2}{3}$ bushels, Ans.

4. If the length of a vat be 70 inches, breadth $16\frac{1}{2}$ inches, and depth 47 inches, what will be the content in wine gallons?

	70— 5
—2	33—
—33 —231	47

| 235 gallons, Ans.

5. If the length of a vat be ten feet six inches long, five feet six inches deep, and three feet eleven inches wide, how many beer gallons will it contain, and hhds., at 63 gallons each?

	126— 2
—6 —282	66— 11
—63	47—

| 22 hhds. or 1386 galls. Ans.

To find the burthen of ships.

Rule. Place the length of the keel in feet, the breadth of the mid-ship-beam, and the depth of the hold, on the right hand side of the line; and 95 on the left for merchant ships, but for ships of war place on the left 100, and the answer will be in tons.

EXAMPLES.

1. What is the tonage of a merchant ship, length of keel 250 feet, depth of hold 11 feet, and breadth of beam 19 feet?

	250— 50
—5 —95	19—
	11
	550 tons, Ans.

2. What is the tonage of a merchant ship, length of keel 275 feet, depth of hold 12 feet 8 inches, breadth of beam 27 feet?

—19 —95	275— 55
—3	38— 2
	27— 9
	990 tons Ans.

3. What is the tonage of a ship of war, length of keel 260 feet, breadth of beam 25 feet, depth of hold twelve feet?

	260
—4 —100	25—
	12— 3
	780 tons, Ans.

4. The proportions of Noah's ark, (Gen. vi. 15,) were as follows: length 300 cubits, breadth 50 cubits, and depth of the hold 30 cubits. Require its burthen, allowing the cubit to be 22 inches?

Ans. 29188,+as a merchant ship.
27729,+" " ship of war.

To find the area of a square, a rectangle, a rhombus, or a parallelogram.

Rule. Place the base and perpendicular heighth on the *right hand side* of the line, and the denomination next *inferior to* that in which we wish our answer on the left *hand side*.

EXAMPLES.

1. Required the area of a square piece of land 80 rods square.

	80— 40
—2 —160	80—

40 acres, Ans.

2. Required the area of a square piece of land 480 rods square.

	480
—160	480— 3

1440 acres, Ans.

3. Required the value of a piece of land $6\frac{6}{11}$ rods square, at $12,10 per acre.

—11	72— 18
—11	72— 18
—4 —160	12,1— 0—

$3,24, Ans.

4. Required the area of a parallelogram, whose length is 480 rods, and width 96 rods.

	480— 3
—160	96

288 acres, Ans.

5. Required the number of acres in the road from New York to Philadelphia, the distance being 96 miles, and the average width 4 rods.

	96
	8
—160	40—
	4—

768 acres, Ans.

6. How many acres in a square piece of land whose side is 32 rods? Ans. $6\frac{2}{5}$ acres.

7. Required the area of a square piece of land whose side is 15 chains? Ans. $22\frac{1}{2}$ acres.

8. How many men can stand on 5 acres of land, each man occupying a space of 3 feet square?

Ans. 24,2 0 men.

9. A gentleman purchased a farm in the form of a square, at 48 dollars per acre. Required the cost allowing the side to be 25 chains. Ans. 3000 dollars.

10. Required the area of a parallelogram, whose base is eighty rods and altitude 25 rods. Ans. 12 acres 2 rods.

11. How many acres in a field in the form of a parallelogram, whose base is 95 rods, and altitude 40 rods?

Ans. 23 acres 3 roods.

12. Required the area of a field in the form of a parallelogram, whose base is 35 chains and altitude ten chains.

Ans. 35 acres.

13. Four gentlemen purchased a farm in the form of a parallelogram, the base thereof was 320 rods and altitude 90 rods, and divided it equally. Required the portion of each. Ans. 45 acres.

14. Required the area of a rectangle, whose base is 28 feet and breadth 9 inches. Ans. 21 feet.

15. How many square feet are there in a rectangular board, whose length is 36 feet and breadth ten inches?

Ans. 30 feet.

16. Required the area of a rectangular farm, whose base is 88 rods, and breadth forty rods. Ans. 22 acres.

17. How many acres are there in a rectangular farm, whose base is fifty chains, and breadth twenty chains?

Ans. 100 acres.

18. Required the area of a rhombus, whose base is 75 rods, and breadth forty rods. Ans. 18 acres 3 roods.

19. How many acres are there in a farm in the form of a rhombus, whose base is forty-five chains, and breadth twenty chains? Ans. 90 acres.

20. Required the area of a rectangular board, whose length is twenty feet, and breadth one foot four inches.

Ans. $26\frac{2}{3}$ feet.

21. Required the area of a parallelogram whose base is *eight hundred* rods, and altitude four hundred rods.

To find the area of a triangle.

Rule. Place the altitude and half the length of the base on the right hand side of the line, and the denomination next inferior to that corresponding with the answer on the left hand side.

NOTE. A triangle is equal to half a parallelogram of the same base and altitude, therefore the truth of this rule is evident.

EXAMPLES.

1. Required the area of a triangle, the base being sixty rods and altitude forty rods.

		30—	15
2	—4 —160	40—	
2		15	$=7\frac{1}{2}$ acres, Ans.

2. Required the area of a triangle, the base being six hundred rods, and altitude eighty rods.

		300—	150
—2	—160	80—	
		150	acres, Ans.

3. Required the area of a triangle, the base being ninety-eight rods, and altitude $61\frac{5}{7}$ rods.

		49—	7
	—7	432—	27
	—16 0		
10		189	$=18\frac{9}{10}$ acres, Ans.

4. Required the area of a triangle, whose base is ninety rods, and altitude sixty rods.

Ans. 16 acres, 3 roods, 20 rods.

5. How many acres in a triangle, whose base is 120 rods, and altitude eighty-four rods? Ans. 31 acres, 2 roods.

6. A gentleman purchased a triangular farm, the base thereof was 480 rods, and altitude 120 rods. Required the cost of said farm at fifty dollars per acre. Ans. $90000.

7. Required the value of a triangular farm, the base being seventy chains, and altitude thirty chains, at sixty-four dollars per acre. Ans. $6720.

8. Required the area of an equilateral triangle whose side is twelve chains, and perpendicular ten chains.
Ans. 6 acres.

9. Required the area of a right-angled triangle whose base is 140 rods, and perpendicular eighty rods.
Ans. 35 acres.

10. Required the area of an isosceles triangle, whose base is forty chains, and altitude thirty-five chains.
Ans. 70 acres.

11. Required the area of a scalene triangle whose base is ninety-four rods, and perpendicular sixty rods.
Ans. 1$\frac{7}{8}$ acres, 2 roods, 20 rods.

12. Eight gentlemen purchased a farm in the form of a right-angled triangle, the base thereof being 480 rods, and perpendicular 140 rods, and divided it equally. Required the share of each. Ans. 26$\frac{1}{4}$ acres.

To measure wood, bark and coal.

Rule. Place the length, heighth and width on the right hand side of the line, and 128 on the left, or 8—4—4 on the left.

NOTE. 128 cubic feet make a cord, and 2688 cubic inches make the bushel of coal or lime, &c., and 268$\frac{4}{5}$ cubic inches make the dry gallon.

EXAMPLES.

1. How many cords of wood in a load twelve feet long, eight feet high, and four feet wide?

	12— 3
—8	8—
—4	4—
—4	

3 cords, Ans.

2. How many cords of wood or bark in a load ten feet eight inches long, five feet four inches high, and four feet six inches wide?

—3	32— 2
—3	16—
—2	9—
—8	
—4	
—4	

2 cords, Ans.

3. How many bushels of charcoal in a load twelve feet long, eight feet high, and four feet wide, allowing 100 bushels to the cord?

	12— 3
—8	8—
—4	4—
—4	100

300 bushels, Ans.

NOTE. Since there are 2688 cubic inches in a heaped bushel, bearing the proportion to the cubic inches in a foot that fourteen does to nine, therefore, if the dimensions of your load be in feet, place the length, heighth, width, and nine on the right hand side of the line, and fourteen on the left hand side for bushels; but if you reduce all the dimensions to inches, you must divide by 2688, or the figures and numbers 8—16—7—3, which being multipled together give 2688.

EXAMPLES.

4. How many bushels of coal in a load ten feet eight inches long, five feet four inches high, four feet six inches wide?

	—3	32
	—3	16— 8— 4
	—2	9—
7	—14	9

7 | 1152=164$\frac{4}{7}$ bushels, Ans.

5. The same reduced to inches.

	128
—8	64— 8—
—2 —16	54— 9
7	
—3	
7	1152=164$\frac{4}{7}$, Ans., as before.

To find the solidity of a globe.

Rule. Place the square of the diameter, the decimal, 7854, 4 and $\frac{1}{6}$ of the diameter of the globe, on the right hand side of the line, and the denomination next inferior to that corresponding to the answer on the left.

EXAMPLES.

1. Required the solidity of a globe, its diameter being thirty-six inches.

	36—
	36— 18
—2 —48 —1728	,7854
	4—
	6—
	14,1372 feet, Ans.

2. Required the solidity of a globe, its diameter being four feet.

	48--- 4
---12	48--- 4
---12	,7854--- 2618
---3 ---12	4---
	8
	33,5104 feet, Ans.

3. Required the solidity of the planet Jupiter, its diameter being 89000 miles. Ans. 369121768400000 miles.

To find the area of a Circle the Diameter and Circumference being given.

RULE. Place the diameter and circumference on the right hand side of the line, and 4, together with the next inferior number corresponding to the answer, on the left hand side.

Proposition 1. Required the area of a circle whose diameter is 70 rods, and circumference 220 rods.

—2 —4	220— 110
32 —160	70— 35— 7
	Ans. 24 acres 10 rods.

2. Required the area of a circular whose diameter is 350 rods and circumference 1100 rods.

3. Required the area of a circular field whose diameter is 140 rods and circumference 440 rods.

4. Six gentlemen purchased a circular farm, the diameter of which was 210 rods and circumference 660 rods, and divided it equally between them. Required the share of each. Ans. 36 acres 0 roods 15 rods.

To find the area of a circle, the diameter being given.

RULE. Place the *square* of the diameter and the decimal ·7854 on the *right* hand side of the line, and the number next inferior to that corresponding to the answer, on the *left* hand side.

Proposition 1. Required the area of a circle whose diameter is 80 rods.

Solution.

—2 —160	80—
	80— 40
	·7854
	Ans. 31 acres 1 rood 25.56 rods.

2. Required the area of a circular field whose dimaeter is sixty-four rods. Ans. 20 acres 17 rods.

3. How many acres in a circular field, the diameter being sixty rods? Ans. 17 acres 2 roods 27 rods.

4. Required the area of a circular field, the diameter being one hundred and twenty rods.

Ans. 70 acres 2 roods 29 rods.

5. Required the area of a circular farm, the radius (or semi-diameter) being eighty rods.

Ans. 125 acres, 2 roods, 26 rods.

6. Four gentlemen purchased a circular farm, the radius of which was forty rods, and paid equally. Required the amount each paid, allowing they bought it at sixty dollars per acre. Ans. $471·24.

To find the superficial area of a globe, the circumference and diameter being given.

RULE. Place the circumference and diameter on the right hand side of the line, and the next inferior number to that corresponding to the answer on the left hand side.

Proposition 1. Required the superficial area of a globe, the diameter being 8 inches and circumference 24 inches.

3 —6 —144 | 24—
8— 4 $1\frac{1}{3}$ feet Ans.

2. Required the superficial area of a globe, the circumference being ninety-six inches and diameter thirty inches.

Ans. 20 feet.

3. Required the superficial area of a globe the diameter being 144 inches and circumference 452 inches.

Ans. 452 feet.

4. Required the superficial area of a ball, the diameter being thirty-six inches and circumference 112 inches.

Ans. 28 feet.

5. Supposing the earth's diameter to be eight thousand miles and the circumference twenty-five thousand miles. How many square miles would there be on its whole surface? Ans. 200000000.

6. Required the number of square miles on the whole surface of Jupiter, the diameter being eighty-nine thousand miles and the circumference 280000 miles?

Ans. 24920000000.

To find the superficial area of a globe, the diameter being given.

RULE. Place the square of the diameter, the decimal ·7854 and 4 on the right hand side of the line, and the number next inferior to that corresponding to the answer on the left hand side of the line.

Proposition 1. Required the superficial area of a globe, the diameter being thirty-six inches.

	36—
—4 —144	36
	·7854
	4—

28.2744 square.

2. Required the superficial area of a globe, the diameter being 144 inches. Ans. 452·3904 square feet.

3. Required the superficial area of the earth, its diameter being eight thousand miles.

Ans. 201062400 miles.

To find the convex surface of a right cone.

RULE. Place the circumference of the base and altitude on the right hand side of the line, and 2 and the next inferior number to that corresponding to the answer, on the left hand side.

Prop. 1. Required the convex surface of a right cone, the circumference of whose base is 72 inches, and slant height of altitude 24 feet.

—2	72— 6
—12	24— 12

72 feet Ans.

2. The circumference of the base of a right cone is 8 feet, and slant height 20 feet, required its convex surface.

Ans. 80 feet.

3. Required the convex surface of a right cone, the circumference of whose base is 96 inches, and slant height 48 feet. Ans. 192 feet.

4. The diameter of a right cone is 21 inches, and the slant height 36 feet; required the convex surface.

Ans. 98·9604 feet.

5. Required the convex surface of a right cone, its diameter being 14 feet, and slant height 60 feet.

Ans. 1319·472 feet.

6. The diameter of a right cone is 4·5 feet, and the slant height 20 feet; required the convex surface.

Ans. 141·372 feet.

7. The circumference of the base is 10·75, and the slant height 18·25; what is the convex surface?

Ans. 98·09375.

To find the convex surface of the frustrum of a right cone.

RULE. Place the sum of the perimeters of the two ends, and the slant height on the right hand side of the line, and 2 and the number next inferior to that corresponding to the answer on the left hand side.

Prop. 1. Required the convex surface of the frustrum of a right cone, the circumference of the greater end being 30 feet, that of the lesser end 10 feet, and the length of the slant side 20 feet.

$$\begin{array}{r|l} -2 & 40 \\ & 20- \ 10 \end{array}$$

400 feet, Ans.

2. Required the convex surface of the frustrum of a right cone, the circumference of the greater end being 60 feet, that of the lesser end 20 feet, and the length of the slant side 40 feet. Ans. 1600 feet.

3. If a segment of twelve feet slant height be cut off a cone whose slant height is 60 feet, and circumference of its base twenty feet. What is the surface of the frustrum? Ans. 576 feet.

4. Required the convex surface of the frustrum of a right cone, the diameter of the greater end being 22 feet, that of the lesser end seven feet, and the length of the slant side 16 feet. Ans. 728,8512 feet.

To find the solidity of a cone or pyramid.

RULE. Place the square of the diameter, the decimal ·7854, and altitude on the right hand side, and 3 and the number next inferior to that corresponding to the answer on the left hand side.

Prop. 1. Required the solidity of a cone, the diameter being twenty inches and altitude or perpendicular height twenty-four feet.

—6	—144	20
	3	20
		.7854— 1309
		24—

17,4533 feet.

2. Required the solidity of a conical church spire, the diameter being twelve feet, and perpendicular height sixty feet. Ans. 2261,952 cubic feet.

3. The diameter of a cone is twenty feet and its perpendicular height twenty-four feet. Required its solidity. Ans. 2513,28 feet.

4. Required the solidity of a conical block of marble, its diameter being 9 feet, and altitude twenty-four feet. Ans. 508,9392 cubic feet.

5. Required the value of a conical marble monument of $12 50 per foot, the diameter of whose base is twelve feet, and perpendicular height thirty-six feet. Ans. $16964,64

MECHANICAL OPERATIONS.

The two arms of a lever and the power being given, to find what weight that power will equiponderate.

Rule. Place the length of the arm to which the power is applied, and the power on the right hand side of the line, and the length of the other arm on the left hand side.

Prop. 1. There is a lever thirty feet long divided by the fulcrum into two arms, one of which is twenty feet, the other ten feet in length. Required the equiponderating weight on the short arm when 120 pounds is suspended at the extremity of the long arm.

—10 | 20— 2
| 120

| 240 pounds, Ans.

2. The arms of a lever are, the one thirty feet and the other four feet in length. What weight will a power of 160 pounds at the extremity of the long arm balance at the extremity of the short arm? Ans. 1200 lbs.

3. How many lbs. will a power of nine lbs. placed fifteen feet from the fulcrum of a lever, support at the extremity of the other arm two feet in length? Ans. 67½.

The arms of a lever and the weight being given, to find the power.

Rule. Place the weight and the length of the arm to which it is suspended on the right hand side of the line, and the length of the other arm on the left hand side.

Prop. 1. A weight of twenty tons is suspended to an arm of a lever six inches in length. What weight at the *extremity of* the other arm forty feet in length will balance *the same?*

[Solution, next page.]

---2 ---12	20--- 10--- 5 cwt. Ans.
—2 —40	20---
	6---

2. A weight of fourteen hundred pounds is suspended to an arm of a lever eight feet in length. What weight at the extremity of the other arm fourteen feet in length will balance the same? Ans. 800 lbs.

3. A weight of four hundred tons is suspended to an arm of a lever ten inches in length. Required the weight at the extremity of the other arm five feet in length that will balance the same. Ans. $66\frac{2}{3}$ tons.

4. A weight of 7200 lbs. is suspended to an arm of a lever three feet in length. What weight at the extremity of the other arm nine feet in length will balance the same? Ans. $1\frac{1}{14}$ tons.

The diameter of the wheel, the diameter of the axle and the power being given, to find the weight.

Rule. Place the diameter of the wheel and the power applied on the right hand side of the line, and the diameter of the axle on the left hand side.

Prop. 1. If the diameter of the axle be six inches and that of the wheel six feet, what weight attached to the axle will sixteen lbs., attached to the wheel, balance?

	6—
—6	12
	16
	192 lbs. Ans.

2. If the diameter of the axle be eight inches and that of the wheel twenty-four feet, what weight attached to the axle will 144 lbs. attached to the wheel balance?

Ans. $2\frac{11}{35}$ tons.

3. If the diameter of the wheel be thirty-six feet and that of the axle four inches, what weight attached to the axle will twelve cwt. attached to the wheel balance?

Ans. $64\frac{4}{5}$ tons.

4. Supposing the diameter of the wheel to be forty-eight feet and that of the axle ten inches, what weight attached to the axle would one hundred tons attached to the wheel balance? Ans. 5760 tons.

5. Supposing the diameter of the wheel to be sixty feet and that of the axle twelve inches, what weight attached to the axle would four hundred tons attached to the wheel balance? Ans. 2000 tons.

The diameter of the wheel, the diameter of the axle, and the weight being given, to find the power.

Rule. Place the diameter of the axle and the weight on the right hand side of the line, and the diameter of the wheel on the left hand side.

Prop. 1. If the diameter of the axle be six inches and the diameter of the wheel twelve feet, what power will balance a weight of 360 lbs.?

—2 —12 | 6—
—12 | 360— 30— 15 lbs. Ans.

2. If the diameter of the axle be eight inches and that of the wheel sixteen feet, what power will balance a weight of 2880 lbs.? Ans. 120 lbs.

3. If the diameter of the wheel be twenty-four feet and that of the axle four inches, what power will balance a weight of forty tons? Ans. $11\frac{1}{9}$ cwt.

4. If the diameter of the axle be nine inches and that of the wheel eight feet, what power will balance a weight of 144 tons? Ans. $13\frac{1}{2}$ tons.

The length, height of the plane and power being given, to determine the weight.

Rule. Place the power and the length of the plane on the right hand side of the line, and the perpendicular height on the left hand side.

Prop. 1. If the length of an inclined plane be sixteen feet and the perpendicular height four feet, what will a power of thirty-two pounds sustain?

[*Solution*, next page.]

—4 | 16— 4
| 32

128 pounds, Ans.

2. What weight will four tons sustain on an inclined plane one hundred and forty-four feet in length, and perpendicular height four feet? Ans. 144 tons.

3. If the length of an inclined plane be eighty-four feet and perpendicular height three feet, what weight will a power of twenty tons sustain? Ans. 560 tons.

4. What weight will twelve tons sustain on an inclined plane ninety-six feet in length and perpendicular height six feet? Ans. 192 tons.

5. If the length of an inclined plane be seventy-two feet and perpendicular height 3½ feet, what weight will a power of one hundred sixty cwt. sustain? Ans. 172½ tons.

The length, height of the plane, and weight being given, to find the power.

Rule. Place the weight and height of the plane on the right hand side of the line, and the length on the left hand side.

Proposition 1. What power will balance one hundred twenty-eight pounds on an inclined plane, the length of which is sixteen feet, and perpendicular height four feet?

---16 | 128— 8
| 4

32 pounds, Ans.

2. What power will balance twelve tons on an inclined plane, the length of which is twenty-four feet, and perpendicular height six feet? Ans. 3 tons.

3. What power will balance twenty tons on an inclined plane, the length of which is seventy-two feet and perpendicular height four feet? Ans. 1⅔ tons.

4. What power will balance one hundred and forty-four cwt. on an inclined plane, the length of which is ninety-six feet, and the perpendicular height nine feet?

Ans. $13\frac{1}{2}$ cwt.

5. What power will balance thirty-six tons on an inclined plane, the length of which is two hundred and forty feet and perpendicular height eight feet? Ans. 24 cwt.

The thickness of the head, the length of the side and the power acting upon the head of the wedge being given, to determine the force produced on the side.

Rule. Place the length of the wedge and the power on the right hand side of the line, and the thickness of the head on the left hand side.

Proposition 1. If the length of a wedge be 12 inches, the thickness of the head 3 inches, and the force applied 64 pounds, what will be the resistance at the side?

$$\begin{array}{r|l} -3 & 12-4 \\ & 64 \end{array}$$

256 pounds, Ans.

2. If the length of a wedge be twenty inches, the thickness of the head four inches, and the force applied one hundred and forty-four pounds, what will be the resistance at the side? Ans. $6\frac{3}{7}$ cwt.

3. If the length of a wedge be thirty-six inches, the thickness of the head six inches, and the force applied nine hundred sixty pounds, what will be the resistance at the side? Ans. $2\frac{4}{7}$ tons.

4. If the length of a wedge be forty-eight inches, the thickness of the head eight inches, and the force applied ten thousand eight hundred pounds, what will be the resistance at the side? Ans. $28\frac{13}{14}$ tons.

5. If the length of a wedge be sixty inches, the thickness of the head five inches, and the force applied eight *tons, what* will be the resistance at the side?

Ans. 96 tons.

The length of the side, the thickness of the head, and the resistance upon the side of a WEDGE *being given, to find the force acting upon the head.*

RULE. Place the resistance at the side and the thickness of the head on the right hand side of the line, and the length of the side of the wedge on the left hand side.

Proposition 1. If the resistance at the side of a wedge be twenty thousand pounds, the length of the wedge twenty inches, and the thickness of the head three inches, what force is required to be applied to counteract the resistance at the sides?

—20 | 20— 000
3

3000 pounds, Ans.

2. If the length of the wedge be thirty-two inches, the thickness of the head two inches, and the resistance at the side be twenty-five thousand six hundred pounds, what must be the force upon the head, no allowance being made for friction? Ans. 1600 lbs.

3. If the resistance at the side of the wedge be twelve tons, the length of the wedge twenty-four inches, and the thickness of the head four inches, what force is required to be applied to counteract the resistance at the sides?

Ans. 2 tons.

4. If the length of the wedge be forty eight inches, the thickness of the head six inches, and the resistance at the side twenty-four tons, what must be the force upon the head? Ans. 3 tons.

The distance between the threads of a SCREW, *the length of the lever, and power applied being given, to find the weight.*

Rule. Place the circumference of the circle described by one revolution of the lever and the power applied on the right hand side of the line, and the distance between the threads of the screw on the left hand side.

Proposition 1. If the threads of a screw be two inches asunder, the lever thirty-five inches in length, and a power of sixty pounds be applied to the end of the lever what weight will be required to produce an equilibrium?

—2 | 220
| 60— 30

6600 pounds, Ans.

2. If the threads of a screw be three inches apart, the lever $24\frac{1}{2}$ inches in length, and a power eighty pounds be applied to the end of the lever, what weight will be required to produce an equilibrium? Ans. $4106\frac{2}{3}$ lbs.

3. Should the threads of a screw be $2\frac{1}{2}$ inches asunder, the lever twenty-eight inches in length, and a power of four tons be applied to the end of the lever, what weight will be required to produce an equilibrium?

Ans. $281\frac{3}{5}$ tons.

4. Should the threads of a screw be $4\frac{4}{11}$ inches asunder, the lever thirteen inches in length, and a power of four tons be applied to the end of the lever, what weight will be required to produce an equilibrium? Ans. $4\frac{1}{4}$ cwt.

The weight of the lever and the distance between the threads of a screw being given, to find the power requisite to produce an equilibrium.

Rule. Place the given weight and distance between the threads of the screw on the right hand side of the line, and the circumference of the circle, described by one revolution of the lever, on the left hand side.

Proposition 1. How many pounds applied to the end of a lever $36\frac{1}{11}$ inches in length will balance twenty tons upon a screw whose threads are two inches asunder?

—2 —224 | 20 pounds, Ans.
| 112—
| 2—

2. How many pounds applied to the end of a lever thirty five inches in length will balance fifteen tons upon a screw whose threads are $2\frac{1}{2}$ inches apart? Ans. $3\frac{9}{22}$ cwt.

3. Required the number of pounds requisite to produce an equilibrium of twenty-four tons upon a screw whose threads are $2\frac{1}{4}$ inches asunder, and lever twenty-eight inches. Ans. $6\frac{9}{14}$ cwt.

4. The threads of a screw are two inches asunder, the length of the lever seventy inches, required the number of pounds to produce an equilibrium, the weight applied to the lever being seventy-two tons. Ans. $6\frac{6}{11}$ tons.

To ascertain the atmospheric pressure upon a cylinder.

Rule. Place the square of the number of inches in the diameter, and 165 on the right hand side of the perpendicular line, and 14 on the left hand side.

Prop. 1. Required the atmospheric pressure upon a cylinder whose diameter is twenty-eight inches.

—14	28— 2—
—28	28—
2 —4	165— $82\frac{1}{2}$ cwt. Ans.

2. Required the atmospheric pressure upon a piston of a steam engine whose diameter is fifty-six inches.
Ans. 16 tons 10 cwt.

3. The diameter of a cylinder is $2\frac{1}{3}$ inches. Required the atmospheric pressure. Ans. $64\frac{1}{6}$ lbs.

4. Required the atmospheric pressure upon a piston of a common pump, the diameter of which is seven inches.
Ans. $577\frac{1}{2}$ lbs.

5. Required the atmospheric pressure upon a piston of a cylindrical vessel whose diameter is seventy inches.
Ans. 25 tons 15 cwt. 2 qrs. 14 lbs.

6. The diameter of a cylindrical vessel is 14 inches. Required the atmospheric pressure upon its piston. $20\frac{5}{8}$ cwt.

7. The diameter of a cylindrical vessel is thirty-eight inches. Required the atmospheric pressure on its piston.
Ans. 7 tons 11 cwt. 3 qrs. 22 lbs.

To find the number of balls contained in a finished triangular pile.

Rule. Place the number of balls contained in the bottom row increased by 2, the number of balls contained in the bottom row increased by 1, and the number of balls contained in the bottom row on the right hand side of the perpendicular line, and 6 on the left hand side.

Prop. 1. Required the number of balls contained in a finished triangular pile, the bottom row consisting of eight on a side.

--2 --6	10
	9— 3
	8— 4
	120 Ans.

2. Required the number of balls contained in a finished triangular pile, the bottom row consisting of thirty on a side. Ans. 4960.

3. How many balls are contained in a finished triangular pile, each side of whose base contains twenty balls? Ans. 1540.

4. Required the number of balls contained in a finished triangular pile, the bottom row consisting of sixty on a side. Ans. 9920.

To find the number of balls contained in a finished square pile.

Rule. Place twice the number of balls contained in the side of the square increased by 1, the number of balls contained in the side of the square increased by 1, and the number of balls contained in the side of the square on the right hand side of the perpendicular line, and 6 on the left hand side.

Prop. 1. Required the number of balls contained in a finished square pile containing twelve in each side.

[Solution, next page.]

	25
—6	13
	12— 2

650 Ans.

2. Required the number of balls contained in a finished square pile, the lower tier containing thirty in each.

Ans. 9455.

3. Required the number of balls contained in a finished square pile, each side containing twenty balls.

Ans. 2870.

4. Required the number of balls contained in a finished square pile, each side containing twenty-three balls.

To ascertain the number of balls contained in a finished rectangular pile.

Rule. To twice the number of courses increased by 1, add the product of the number less by 1 in the top row multiplied by 3, and place the sum, together with the number of courses increased by 1, and the number of courses on the right hand side of the line, and 6 on the left hand side.

Proposition 1. The number of courses in a finished rectangular pile is thirty, and the number in the top row is thirty-one, required the number contained in the pile.

	151
—6	31
	30— 5

23405 balls, Ans.

2. The number of courses in a finished rectangular pile is twenty, and the number in the upper course is twenty-four, required the number contained in said pile.

Ans. 7,700.

3. The number of shot in the upper course of a finished

rectangular pile is forty-one, and the number of courses, thirty, how many shot are contained in said pile.

Ans. 28055.

4. How many shot in a finished rectangular pile, the length of the bottom course being fifty-nine and its breadth twenty? Ans. 11060.

MACHINERY.

To ascertain the number of revolutions that a drum, pulley or spindle will make, when connected together by belts or bands, the velocity of one and diameter being given.

Rule. Place the velocity and diameter of the drivers on the right hand side of the perpendicular line, and the diameter of the driven on the left hand side of the line.

Prop. 1. A belt connects a drum of two feet in diameter, making forty revolutions in a minute with one of four inches in diameter. Required the velocity of the smaller drum.

$$\begin{array}{r|l} -4 & 40 \\ & 12 - 3 \\ & 2 \end{array}$$

240 revolutions per min. Ans.

2. How many revolutions will a spindle of two inches in diameter make, connected to a drum of three feet in diameter performing thirty revolutions per minute?

Ans. 540.

3. A drum of four feet in diameter performs sixty revolutions per minute. Required the diameter of that drum, whose velocity is 576 revolutions per minute.

Ans. 5 inches.

4. What is the twist of yarn per inch, spun on a mule with the following geer, pullies, &c.: geer on front roller, 54 teeth; geer on lower end of tumbling shaft, 27 teeth; geer on upper end of tumbling shaft 44 teeth; geer on fly wheel shaft, 50 teeth; diameter of fly wheel, 36 inches; diameter of twist pully, where rim band runs, *16 inches*; diameter of twist pully, where drum bands

run, 12½ inches; diameter of drum, where the drum band runs, 10½ inches; diameter of drum where spindle band runs, 10 inches; diameter of spindle whirl, 1 inch; diameter of front roller, 1 inch.

Solution.

		—27	54—	2—	
	—2	—50	44—	2—	
—2	—8	—16	36—	12—	3
		—2	25—		
	—3	—21	2—		
			10—	5	
		—22	7—		

15 turns per inch Ans.

5. What is the draft of a spinning frame, front roller 1½ inches; diameter of back roller ⅝ of an inch; pinion on front roller 40 teeth, stud 84 to 21 teeth; geer on back roller 50 teeth.

	—2	3—		
	—6	8—		
—5	—40	84—	4—	
	—21	50—	10	

10 is to 1, Ans.

SQUARE ROOT.

The square of a number is the product arising from a number multiplied into itself.

The extraction of the square root is the finding of such a number as, being multiplied itself, will produce the number proposed.

Rule. Separate the given number into periods of two figures, each beginning at the units' place.

Subtract from the first period at the left hand the greatest square it contains, setting the root of that square as a quotient figure, and doubling said root for a divisor, and bring down the second period to the remainder for a dividend.

Try how often the said divisor (with the figure used in the trial thereto annexed) is contained in the dividend, and set this figure in both the divisor and root; then multiply and subtract, as in division, and bring down the next period. Double the ascertained root for a new divisor, and repeat the process to the end.

PROOF. Square the root, adding in the remainder, if any, and the result will equal the given number.

EXAMPLE.

What is the square root of 30138,696025?

```
                * *  * *
1  )  30138, 696025 (173,605
1     1
-----------
27)   201
 7    189
-----------
343)  1238
  3   1029
-----------
3466)  20969
   6   20796
-----------
347205)  1736025
         1736025
         -------
```

CUBE ROOT.

The cube of a number is the product of that number multiplied by its square.

The extraction of the cube root is the finding of such a number as, being multiplied into its square, will produce the number proposed.

RULE. Point off the given numbers into periods of three *figures each*, and find the nearest cube to the first period ;

subtract it therefrom, and put the root in the quotient; then thrice the square of this root will be the trial divisor for finding the next figure.

Set off a little to the left the next figure; with thrice the peceding figure of the root; multiply this by the last figure, and set this under the trial divisor, remove it two figures to the right, and the sum will be the true divisor.

Under this divisor put the square of the last period figure of the root, which add to the two sums above, and the sum will be the trial divisor for finding the next figure of the root; then the true divisor is found, as before.

EXAMPLES.

1. What is the cube root of 205379 ?

3 multiplied by $\frac{2}{5}$ = 75		205379(59
159	1431	125
	8931	80379
		80379

2. What is the cube root of 122615327232 ?

$3\times\frac{4}{4}$ = 48		122615327232(4968 Ans.
129	1161	64
	5961	58615
	81	53649
	7203	4966327
1476	8856	4374936
	729156	591391232
	36	591391232
	738048	
17888	119104	
	73923904	

3. Require to extract the cube root of 2205 to 19 places.

507	2205(13,01575997906296270
3901 . . . . ,3901	2197
507,3901	8
,0001	5073901
507,7803	2926099
39,035 . . . 195175	2539877375
507,975475	386221625
25	355738604893
508, 17075	30483020107
39,0457 2733199	25411364591375
508, 19800699	5071655515625
49	4574066360515
508, 22533947	497589155110
39,04715 . . . 19523575	457406983963
508, 2272918275	40182171147
. . . 25	35576101403
508, 2292441875	4606069744
39,0,4,7,4,5,9 3514253	4574070209
508,229595612,8	31999535
	30493801
508,229947038	
35143	1505734
	1016460
508,22998218,1	
	489274
508,23001732	457407
273	
	31867
508,2300200,5	30494
508,2300228	1373
4	1016
	357
5,0,8,2,3,0,0,2,3,2	355

APPLICATION OF THE SQUARE AND CUBE ROOT.

1. A certain pavement is made exactly square, and each side of it contains 97 feet, how many square feet are contained therein? Ans. 9409.

2. A certain square pavement containing 20736 square stones, all of the same size, what number is contained in one of its sides? Ans. 144.

3. A certain number of men gave $3,61 for a charitable purpose, each man gave as many cents as there were men, how many men were there? Ans. 19.

4. If 484 trees be planted in a square orchard, how many must there be in a row each way? Ans. 22.

NOTE. The square of the longest side of a right angle triangle is equal to the sum of the squares of the other two sides, and consequently the difference of the square of the longest and either of the others is the square of the remaining one.

5. The wall of a certain fortress is 17 feet high, which is surrounded by a ditch 20 feet in breadth, how long must a ladder be to reach from the outside of the ditch to the top of the wall? Ans. 26¼ feet.

6. A line of 36 yards long will exactly reach from the top of a fort to the opposite bank of a river, known to be 24 yards broad, the height of the wall is required?

Ans. 26,83 yds.

7. Suppose a ladder 60 feet long be so planted as to reach a window 37 feet from the ground on one side of the street, and without moving it at the foot, will reach a window 23 feet high on the other side, what was the breadth of the street? Ans. 102,64 feet.

8. A certain tree is broken off 8 feet from the ground, and resting on the stump touches the ground at the distance of 12 feet, what is the length of the part broken off?

Ans. 14,42 feet.

9. Two ships sail from the same port, one due east and the other due north, what is the distance between them when one has sailed 100 miles and the other 168 miles?

Ans. 195¼+ miles.

10. A man shot a bird sitting on the top of a steeple 80 feet high while standing at the distance of 60 feet from its base, how far did he shoot? Ans. 100 feet.

11. Two boys were playing with a kite, the line of which was 520 feet in length, when the string was all out, one of them standing directly under it and the other holding the string, the distance between them was 312 feet, what was the perpendicular height of the kite. Ans. 416 feet.

12. If a pipe whose diameter is $1\frac{1}{2}$ inches fill a cistern in 5 hours, in what time will a pipe of $3\frac{1}{2}$ inches diameter fill the same? Ans. $54\frac{2}{7}$ minutes.

13. Suppose a cellar to be dug that shall be 12 feet every way, in length, breadth and depth, how many solid feet of earth must be taken out to complete the same?

Ans. 1728.

14. A gentleman laid out £691 4s. in cloths, but forgot the number of pieces purchased, also how many yards were in each piece, and what they cost him a yard, but he remembers that they cost him as many shillings a yard as there were yards in each piece, and that there was just as many pieces. Query, the number purchased?

Ans. 24.

15. What is the side of a cubical mound equal to one, 144 feet long, 108 feet broad and 24 feet deep?

Ans. 72 feet.

16. If a ball 6 inches diameter weigh 8 lbs. what is the weight of another 12 inches diameter? Ans. 64 lbs.

17. What would be the value of a globe of silver one foot in diameter, if a globe of the same, one inch diameter, be worth $6? Ans. $10368.

18. Suppose the diameter of the sun to be 110 times as large as that of the earth, how many bodies like the earth would be required to make one as large as the sun?

Ans. 1331000.

19. If a globe of silver one inch in diameter be worth $6, what is the diameter of another globe of the same metal, worth $10368?

To extract the square root of a vulgar fraction.

RULE. Reduce the fraction to its lowest terms, then extract the square root of the numerator for a new numera-

tor, and the square root of the denominator for a new denominator.

If the fraction of a surd (i. e.) a number whose root can never be exactly found, reduce it to a decimal and extract the root from it.

PROBLEMS.

PROBLEM I.

When the sum of two numbers is given with their difference, *to find those numbers.*

RULE. To half the sum add half the difference, and their sum will be the larger number. From half the given sum, take half the difference, and the remainder will be the smaller number.

EXAMPLE.

The sum of two numbers is 98, and their difference 14; what are those numbers?

2)98	2)14
49 half the sum.	7 half their difference.
7	49
42 smaller number.	56 larger number.

PROBLEM II.

When the sum of two numbers is given, and the difference of their squares to find those numbers.

RULE. Divide the difference of their squares by the sum of their numbers, and the quotient will be the difference of the numbers; then by Problem 1st find those numbers.

EXAMPLE.

The sum of 2 numbers is 60, and the difference of their squares 1200—what are those numbers?

60)1200

20 diff. of the num.

By Problem 1st.

2)60	2)20
30	10 half,
10	30
20	40 greater num.

There is a pole 100 feet high; how far from the ground must the pole be cut off, and resting on the stump the end shall reach the ground 60 feet from the bottom of the stump? Ans. 32 feet.

NOTE. In this question the length of the pole is the sum of two numbers, and the square of 60 is the difference of their squares.

PROBLEM III.

When the sum of two numbers is given, with the sum of their squares *to find those numbers.*

RULE. From half the sum of the squares subtract the square of half the sum of the numbers, and the square root of the remainder will be half the difference of those numbers; then by Problem 1st find those numbers.

EXAMPLE.

The sum of two numbers is 60, and the sum of the squares 2000—what are those numbers?

2)2000 sum of the squares,

1000 half the sum of squares,
900 square of ½ the sum of the numbers.
100 square root of remainder—10 the difference of the numbers required.

2)60 sum of the numbers,

30 — 30—half the sum of the number,
10 sub't. 10 add

20 and 40—numbers required.

There is a right angle triangle; the hypotenuse is ten feet, the base and perpendicular 14 feet—the length of the base and perpendicular each required. Ans. 6 and 8.

PROBLEM IV.

When the sum of the squares of two numbers is given, and the difference of the numbers to find those numbers.

RULE. From the sum of the squares subtract half the square of the difference; the square root of half the remainder will be half the sum of those numbers; then by Problem 1st find those numbers.

EXAMPLE.

The sum of the squares of two numbers is 2000, and the difference of the numbers 20. What are those numbers?

Sum of the square,	2000
Half the square of the difference,	200
	2)1800
Half the number,	900

30 square root of half the remainder, which is half the sum of the numbers; to which, if 10 be added, the sum will be 40; if subtracted it will be 20.

A and B played at hazard, B losing would play no longer, and on counting they found the difference of their sums to be 12, and the sum of the squares 272; how many dollars had each when they quit? Ans. A 16, B. 4.

There is a right angled triangle whose hypotenuse is 10 feet; the difference of the base and perpendicular 2 feet,—the length of base and perpendicular, each, required.

Ans. 6 and 8.

PROBLEM V.

The product of two numbers given, and the sum of the numbers to find the numbers.

RULE. From the square of half the numbers subtract the product; the square root of the remainder will be half the difference of the numbers. Numbers then found by Problem 1st.

EXAMPLE.

The product of two numbers is 20; the sum of the numbers is 12. What are the numbers?

Product $20-\frac{1}{2})12$

6	half the sum,
6	6
	4
36	
20	10

Remainder 16 square root 4, which is $\frac{1}{2}$ the difference of the numbers.

There is a right angled triangle whose area is 24 feet, base and perpendicular 14 feet,—the length of base and perpendicular required. Ans. 6 and 8.

PROBLEM VI.

The product of two numbers and the difference of the numbers given to find the numbers.

RULE. To the product add the square of half the difference; the square root of the sum will be the sum of half the numbers. Then proceed as Problem 4th.

EXAMPLE.

The product of two numbers is 32, and the difference of the numbers 4. What are the numbers? 32 product.
Ans. 8 and 4.

[Solution on next page.]

2)4 difference,

2 half the difference,
2

32 product, 4 square of ½ the difference.
4

36(6 square root, half the sum of numbers,
6

36 square of half the numbers,
32 product,

4(2 square root,
6 6 sum of half the numbers,
2 2

8&4 the numbers required.

A right angled triangle, the area is 24, the difference of the base and perpendicular is 2,—required the length of the base and perpendicular each. Ans. 6 and 8.

A merchant mixed thirty dollars' worth of American gin with thirty dollars' worth of Holland gin. There were 60 gallons of the mixture; the Holland gin was worth 6 shillings per gallon more than the American. How many gallons were there of each, and what per gallon?

Ans. 40 galls. at 61s. and 20 galls. at 12s.

Note. 1st find the medium price.

2d. Suppose any two numbers whose difference is given, one of which must be more than the given price.

3d. By allegation alternate, find a number that is worth the medium price.

4th. Find the value of the mixture, and if the two quantities which compose it amount to equal sums, the supposed prices are right. If their sums are not equal, add them together and halve the sum.

5th. By Problem 6th find two numbers whose difference is the difference of the least supposed number and the quantity that may be placed against it. By the process

in allegation alternate and their products the half value of the mixture, one of the numbers so found will be the required price, and the given difference being added to it will be the other required number. Then find the quantity of each by the single rule of three.

Suppose 10 and 4 medium 8

8 {	10 . 4 . . . 40	5 . . 5	
	4 . . 2 . . 8	1 1	
	2)48	4 & 6	
	24	6	the American gin 40 gallons,
	1	6	
	25(5	12	Holland gin 30 gallons.

PROBLEM VII.

The sum of the square of two numbers given, and the product to find those numbers.

RULE. From the sum of the square take twice the product, and the square root of the remainder will be the difference of the numbers. Then proceed as in Problems 4th and 1st.

Or, to the sum of the squares add twice the product; the square root of the sum will be the sum of the numbers. Then find the numbers by Problem 3d.

EXAMPLE.

The product of two numbers is 8, the sum of their separate squares is 20. What are the numbers?

Ans. 2 and 4.

20 sum of the squares,
16 twice the product,

36(6 square root and sum of the numbers.
10 half the sum of the numbers,
9 square of half the numbers.

3 – 3 1(1 square root of the difference and ½ the difference of the numbers.
1 1

4 & 2 the numbers required.

The hypotenuse of a right angled triangle is 10 feet, the area is 24 feet,—what is the length of the base and perpendicular, each? Ans. 6 and 8.

NOTE. Twice the area is the product, and the square of the hypotenuse is the sum of the squares.

PROBLEM VIII.

The sum of the product of two numbers with the square of one of them given; also the sum of the numbers given to find those numbers.

Rule. Divide the sum of the product and square by the sum of the numbers; the quotient is the number to be squared.

The product of two numbers with the square of one of them is 12, and the sum of the numbers is 6,—what are the numbers? Ans. 2 and 4.

Sum of the numbers 6	12 the number given,
2	—
—	2 smaller number.
Large number 4	

PROBLEM IX.

The relation of two numbers and their products given to find their numbers.

Rule. Divide the product by the product of the numbers denoting the relation. The square root of the quotient multiplied by each of the figures denoting the relation; the product will be the numbers required.

EXAMPLE.

The relation of two numbers is as 3 to 4, the product 48; numbers required.

4	12)48
3	—
—	4
12	—
	3 - 4
	2 2

6 & 8 answer.

The area of a right angled triangle is 24 feet, the base is to the perpendicular as 3 to 4—what is the length of each? Ans. base 6, perplr. 8.

PROBLEM X.

The relation of two numbers given and the sum of their squares to find the numbers.

Rule. Divide the sum of the squares by the sum of the squares denoting the relation. The square root of the quotient multiplied by each of the numbers denoting the relation of the product will be the numbers required.

EXAMPLE.

The relation of two numbers is as 3 to 4, the sum of their squares is 100—what are the numbers?

3 4	3 4	25)100
2 2	3 4	
		4(2 sqr. root.
Ans. 6 & 8	9 16	
	9	
	25 sum of the squares.	

The hypotenuse of a right angled triangle is 10 feet, the base to the perpendicular is as 3 to 4—what is the length of each? Ans. base 6, perplr. 8.

PROBLEM XI.

Having the area and the sum of the sides of a right angled triangle given to find the sides.

Rule. Divide the square of double the area by the square of the sum of the sides; the square root of the quotient subtracted from half the sum of the sides, the remainder will be the longest side or hypotenuse, which, being subtracted from the sum of the sides, the remainder will be the sum of the remaining sides, which find by Problem 3d.

NOTE. The square of the hypotenuse will be the sum of the squares of the two remaining sides.

EXAMPLE.

Let the area of a right angled triangle be 6 rods, and the sum of the sides 12 rods,—what is the length of each side?

6
2

12 double the area,
12

144 square of double the area,

6 half the sum,	12 square of sum of the sides,
1 of sides,	12
5 hypotenuse,	144(144
12	1(1 square root of quotient,
5	5 hypotenuse,
7 sum of sides.	5
	2)25 square of sum of sides,
	12,5 half the sum of the sqrs.

2(7

3,5 half the sum of the numbers,
3,5

175
105

12,25 squares of half the sum of the numbers,
12,50 half the sum of the squares,
12,25

,25(,5 square root,
2)7 sum of the sides,

3,5 - - 3,5
,5 ,5

3, and 4, Ans.

PROBLEM XII.

When a sum is involved in its square, and the sum is required.

Rule. Proceed as in the extraction of the square root, but deduct from the given sum the quotient figures, units from units, tens from tens, &c., and in decimals, tenths from tenths, hundredths from hundredths, &c., and the quotient will be the involved root required.

EXAMPLE.

15363,3525 is a number with its square root involved,—what is the number?

```
. . . . .
15363,3525)12345
1
-----
22(53
 44
-----
243(963
 729
-----
 234
 123 quotient, whole numbers,
-----
2464)111,35
     9856
     ----
     1279
        4 quotient, decimals in place of tenths,
     ------
24685)123925      500
      123425      5 . . quotient in place of hund'ths.
      ------      ---
         500      000
```

A gentleman being asked how much money he had, said, in his pocket and purse he had $528,75, but the sum he had in his pocket was the square root of what he had in his purse. How much had he in his purse?

Ans. $22,50.

PROBLEM XIII.

To find the involved square root of any given number, the square of which shall be equal to $\frac{1}{2}$ $\frac{1}{3}$ $\frac{2}{3}$ $\frac{3}{4}$ &c. of the remainder given.

Rule. Divide the denominator by the numerator, multiply the given number by the quotient, extract the involved square root of the product, which being divided by the number which the given number was multiplied, the quotient will be the root required.

NOTE. If it be required that the square of the involved root be 2, 3, 4, &c. times larger that the remainder, the given sum must be divided by the number denoting the fold, and the involved square root of the quotient must be multiplied by the same number.

EXAMPLE.

A gentleman having a piece of land 10 feet wide and 20 feet long, which was too wet for cultivation, he dug a ditch the length of it as deep as it was wide, and within the 10 feet the earth being thrown on the remaining ground raised it a half foot. What was the size of the ditch?

1)2 10 the width of the ground,
2 2
—
2 —
20(4 involved root,
16
—
4 2)4
4 —
— 2 ditch 2 feet square.
0

PROBLEM XIV.

If it be required to find the side of a square which is in depth to its width as 2 to 3, 3 to 4, 4 to 5, &c. within any given number which square shall be $\frac{1}{2}$ $\frac{1}{3}$ $\frac{2}{3}$ $\frac{3}{4}$ &c. or 2, 3, 4, &c. times as large as the remainder of the number given.

Rule. Multiply or divide the given number, as the question may require, as directed by problem 13th; state as

the width required is to the depth, so is the product or quotient to a fourth number. The involved square root of that fourth number will be the depth required; then as the proportioned depth is to the proportioned width, so is the actual depth to the actual width.

EXAMPLE.

There is a piece of land 42 feet wide and 100 feet long to be ditched its length and within its width. The depth of the ditch to its width as 3 to 4, and so large that the earth thrown from it will raise the remaining ground two-thirds of a foot—what is the size of the ditch?

Ans. depth 4 feet, width 6.

2)3 Width. Depth.
as 3 is to 2 so is 63
1,5 den'r of number, 2
42 3)126
1,5 width of ground, 1,5)6,0 42)6
210 Ans. 4 depth, 36
42
63,0 F. D. F. W. F. D. 6
2 - - 3 - - - 4 6 quotient
3 -
0
2)12

Ans. 6 feet wide.

PROBLEM XV.

To find what number by being squared will increase 1, 2, 3, 4, &c.

RULE. Extract the involved square root of the number denoting the increase, to which root add unity or 1, and the sum will be the number required.

EXAMPLE.

What number by being squared will increase 6?

Increase.

6 | 2
4 1 unity,

2 3 Answer.
2 quotient square root.

PROBLEM XVI.

When two numbers are given, increasing equally alike, to find when the smaller number will become the square root of the larger.

RULE. Subtract the smaller number from the larger number; extract the involved square root of the remainder; to which add unity, and that sum will be the smaller number.

EXAMPLE.

N. is 34 1-2 years old when B. is 4 1-2 years old, what will B.'s age be when A.'s age is the square of his?

34,5
4,5

31,(5 root,
25, unity,

5 6 years, Answer.
5 quotient, square root.

A man being asked how much money he had, said, extract the square root from the sum I have; the remainder will be $21,84 cents. How much money had he?

Ans. $27,04.

PROBLEM XVII.

When the sum of the squares of two numbers is given, one the square root of the other, to find those numbers.

RULE. Extract the involved square root, which will give the larger number, and the square root of that will be the smaller number.

EXAMPLE.

The sum of the squares of two numbers is 20, one the square root of the other. Numbers required.

Answer: 2 and 4.

4(2 smaller number,	20(4 larger number,
4	16
—	—
0	4
	4 quotient.
	—
	0

The square of the hypotenuse of a right angled triangle is 90 feet, the base is the square root of the perpendicular. Required the length of each.

Ans.: base 3, perpendicular 9.

PROBLEM XVIII.

When the sum of the squares of two numbers is given, and the sum of the squares twice the product, and sum of the numbers also given, to find the numbers.

RULE. From the sum of the squares twice the product, and sum of the numbers, extract the involved square root, which root will be the sum of the numbers; then by Problem 3d find the numbers.

EXAMPLE.

The sum of the squares of two numbers is 20; the sum of the squares twice the product, and the sum of the numbers is 42. What are the numbers?

[Solution, next page.]

42(6 sum of the numbers,
36
—
6 2)20 square of sum of numbers,
6 —
6 quot'nt. 10 half square.
—
0 9
—
1 difference and square root.

2)6 half sum of numbers,
—
3 3 · · 3
1 1
———
2 and 4 Answer.

The square of the hypotenuse of a right angled triangle, after deducting the base and perpendicular, is 32, and the length of the base and perpendicular added to twice the area, the sum will be 29. What is the length of the base and perpendicular? Ans.: base 4, perpendicular 5.

Note. The 32 is the square of two numbers less the sum, the 29 is the product of two numbers more the sum; 29 and 32 added is 61, and is the sum of the square and product of two numbers; and the 29 added to 61 the sum will be the sum of the squares, twice the product and sum of the numbers.

LEMMA 1st. If the square root of any number be multiplied, the product will be the square of the square multiplied by the square root of the number by which the root was multiplied.

Explanation. Let 100 be the square and 10 its root; 10 multiplied by 4 is 40, which is the square root of 1600, or of 100 multiplied by the square of 4.

LEMMA 2d. If the square root of any number be divided, the quotient will be the square root of the square divided by the square of the number by which the root was divided.

Explanation. Let 100 be the square and 10 its root; 10 divided by 4 is 2.5, which is the square root of 6.25, or *of 100 divided* by 16, or the square of 4.

LEMMA 3d. If a number with 2, 3, 4, &c. times its root be involved, be divided by the square of the number by which its root is involved, the quotient will be the number with its root.

Explanation. Let 100 be the number, and 20, twice its root, added together, will be a number with twice its root involved; 120 is a sum with twice its root involved, divided by 4 (which is the square of the fold of the root,) gives a quotient of 30, which is a number with its root; then by Problem 12th the root is found.

LEMMA 4th. If a number is involved with the square root of 2 or 3 times its number, divide said number by the figure denoting said fold, and the quotient will be a square with its root; then by Problem 12th the root is found.

Explanation. Let 100 be a number, therefore 20 will be the square root of 4 times its number, consequently 120 will be a number with the square root of 4 times its number involved.

Question. A man being asked how much money he had, said, multiply the sum by 4, the square root of that product added to the sum I have, will be $440. How much money had he? Answer: $400.

```
4)440(10
 ---
 110 a number with its square root involved,
  1                        10
 ---                        4
20)10                      ---
  10 quotient.             40 involved root,
 ---
  10
 ---
 100
   4
 ---
 100 Answer.
```

Note. 440 is a number; one part multiplied by 4 is equal to the other part required.

LEMMA 5th. Any two numbers that are in proportion as one is one, and the involved square root of one. The difference of their square is equal to their product. Any two numbers whose difference is 1, 2, 3, &c., the difference of their squares will be 1, 2, 3, &c. times their sum, and any two numbers whose difference is the involved cube root of one; the difference of their cubes is equal to the sum of their squares.

Required two numbers, the difference of whose squares is equal to their product, and their product equal to 3 times their sum. Answer: 4,854101 and 7,854101.

Diff.	No.
If ,618043 require	1
Diff.	
what will 3 require?	

Answer: 4,854101, to which add 3, the sum will be 7,854101, the other number.

Required two numbers, the difference of whose squares is equal to their product, and the difference of their cubes equal to the sum of their squares.

Divide 100 dollars between A. and B., let A.'s part be to B.'s as B.'s is to 100.

Note. As the product of the first and third of 3 numbers, that are in proportion to each other, is equal to square of the second number, it is obvious that the 100 dollars must be so divided that one part squared must be equal to the other multiplied by 100, or is a number with the root of 100 times its number involved. See the rule by Lemma 4th.

[Solution, next page.]

100)100

100(0,618034 involved root of 1,
36
64 1
6 quotient, 0,618034 square root,
,381966 square,
121) 400 100
121
38,196600 A.'s part,
279 61,803400
1 quotient,

1228)17900 ,618034
9824 100
8076 61803400
8 quotient,

123603)760000
370809
389191
3 quotient,

1236064(8919100
4944256
3974844
4 quotient.

A. and B. bought a farm of 300 acres, at $2 per acre, each paying equally; a brook ran through the farm, dividing it into two parts equally valuable, but the western part was worth six shillings per acre more than the eastern: how many acres were there in each part, and what was the land worth per acre?

Answer: The western part contained Acres.
122,79979
Shillings.
and was worth - - - - 19,544003
Acres.
The eastern contained - - - - 177,20021
Shillings.
and was worth - - - - - 13,544003

PROBLEM XIX

The sum of the three numbers which are in arithmetical proportion, and the sum of their squares given to find the numbers.

RULE. Divide the sum of the numbers by three, the quotient will be the second number, which, being subtracted from the sum of the numbers, the remainder will be the sum of two other numbers, and being squared and subtracted from the sum of the squares, the remainder will be the sum of the square of the two other numbers, which numbers are found by Problem 3d.

EXAMPLE.

The sum of three numbers which are in arithmetical proportion is 12, the sum of their squares is 66: what are the numbers? Answer: 1, 4 and 7.

3)12 sum of the numbers,

4 second number,

4 — 66 sum of the squares,

16 square, — 16

50 sum of the square of the other two numbers, which are found by Problem 3d.

PROBLEM XX.

If the sum of 1, 2, 3, 4. &c. time, the third and first numbers added to the sum of the numbers, be given with the sum of the square of the numbers, for every addition *add two to three*, by which sum divide the given numbers

and the quotient will be second number. Then proceed as above, and twice the second will be the sum of the other two numbers.

Note. The second number of any three numbers which are in arithmetical proportion is one-third of the sum of the numbers.

There are three numbers in arithmetical proportion, the sum of the numbers, with the addition of the first and third numbers, is 15, and the sum of the squares is 29. What are the numbers? Ans. 2, 3 and 4.

QUESTIONS,

SOLVED BY RULE OF THREE DIRECT, OR INVERSE.

There is a cistern which has a stream of water running into it; it has ten cocks; all running together will empty it in 2 1-2 hours, 6 will empty it in 5 1-2 hours. How long will it take three to empty it? Answer: 55 hours.

Note.—The 6 cocks will discharge in 4 1-6 hours what the 10 cocks will in 2 1-2 hours, therefore it would take the 6 cocks 1 1-3 to discharge what would run into the cistern in 3 hours, therefore it would take the 6 cocks 1,111 to discharge what would run in in 2 1-2 hours; consequently, 2 2-3 cocks to discharge the water as fast as it run in.

There is a stick of timber 12 feet long, to be carried by 3 men; one carries at the end, the other two carry by a lever; how far must the lever be placed from the other end, that each may carry equally?

Answer: 3 feet from the end.

Note. All bodies gravitate in an inverse proportion to *the distance* of the centre of gravity.

As 1 is to 6, the centre, so is 2 to the answer required.

M.	F.	M.
As 1 . .	6 . .	2
	1	
	2)6	
	3 Answer.	

A stick of timber 30 feet long, to be carried by 5 men, two carry at one end, the other three by a lever; how far from the centre must the lever be placed that all may carry equally?

M.	F.	M.
As 2 . .	15 . .	3
	2	
	3)30	
	10 Answer.	

A. and B. carries a stick of timber 30 feet long; A. carried 8 feet from the centre of the stick, and B. 10 feet; what part of the stick does each carry?

A. 8
B. 10

Answer, { A. 16 2-3
B. 13 1-3

18 . . 30 . . 8	as 18 . . 30 . . 10
3	10
18)240	18)300
13 1-3 feet.	16 2-3 feet.

If 4 acres will pasture 40 sheep 4 weeks, and 8 acres will pasture 56 sheep 10 weeks, how many sheep will 20 acres pasture 50 weeks? Answer: 108 sheep.

Note. 32 sheep will eat the pasture of 8 acres in the 10 weeks, provided the grass had not grown but 4 weeks, therefore it took 24 sheep 10 weeks to eat what grew in 6 weeks, therefore it would take 40 sheep to eat the grass

that will grow on 8 acres; consequently, the grass grows on each acre sufficient to keep 5 sheep, and the pasture on each acre is sufficient to keep 20 sheep one week.

Note. The grass is continually growing.

A. and B. carries a stick of timber 30 feet long; A carries 8 feet from the centre, and carries 16 2-3 feet: how far from the centre must B. carry to carry the remainder?

Ans. : 10.

feet. feet. feet.
As 16,666 is to 8 so is 13,333 to 10 Answer.

QUESTIONS FOR EXERCISE.

1. If 12 oxen will eat $3\frac{1}{3}$ acres of grass in 4 weeks, and 21 oxen will eat 10 acres in 9 weeks, how many oxen will eat 24 acres in 18 weeks, the grass standing equal on every acre and growing uniformly? Ans. 36 oxen.

2. What distance from the corners of a square stick of timber, a side being 28 inches, must lines be drawn for the purpose of hewing it 8 square or an octagon?

Ans. 8,201 inches.

3. P's farm is a mile long and of an equal breadth; Q's farm is a square, containing the same quantity of land as P's; deduct the breadth of P's from its length, and the remainder will be the length of a side of Q's, which side is required? Ans. 197,77 rods.

4. There are 4 wheels taking hold of each other, the first has 33 teeth, the second 34, the third 36, and fourth 38, how many revolutions will each wheel have made when they shall all come to the same teeth where they began?

1st =3876
2 =3762
3 =3553
4 =3366
} Revolutions.

5. A lets B have 1000 lbs. of live sheep on the condition *that* B doubles the weight at the end of 4 years, but A *requests his* just proportion at the end of two years. *Query, what* weight shall A receive?

Ans. 1414, 21356+ lbs.

6. A sugar loaf of a conical form, whose slant heighth was 15 inches weighed 14 lbs. I want to cut off 3 lbs. from the top of this loaf by a plane parallel to the base, at what distance from the top, measured on the slant heighth, must this section be made? Ans. 8,97 inches.

7. Suppose three men, A, B and C, to travel round a course of 5 miles in circuit, A at the rate of 6 miles per hour, B 5, and C 4 miles per hour, at what distance must they be placed from each other at starting, so that traveling the same way, they may all come together in 21 hours?

Ans. 1 mile apart.

8. A grazier bought in as many sheep as cost him £60, out of which he reserved 15 and sold the remainder £54, and gained 2 shillings a head by them, how many sheep did he buy, and what did they cost him per head?

Ans. 75 sheep, 16 shillings per head.

9. A wagoner drove a certain distance with his empty wagon, at the rate of three miles per hour, and returned with a load at the rate of 2 miles per hour, accomplishing the whole journey in 25 hours. What distance did he travel? Ans. 30 miles.

10. Viewing through a telescope a brick house at a distance, I observed that the telescope took in exactly 17 courses of the brick work, I then measured 90 yards directly towards the house and found that the field of the telescope now took in only 12 courses. Required the distance of the house from each place of observation.

Ans. 306 yards from the first place.

11. The area contained at the centre between six equal circles is ten acres. Required the diameter of the smallest circle which will just enclose the whole.

Ans. 29,6 chains.

12. There are two pillars in a straight line, perpendicular to the plane of the horizon, whose distance asunder is 180 feet, the one is 60 and the other 40 feet high; in what part of the line of distance a ladder may be fixed so as to reach the top of each pillar, without moving its bottom; also the length of the ladder?

Answer, 95,55 feet from lesser.
103,589 feet ladder.

13. A man that in stature is just six feet high,
From his lowermost parts to his eye,
Stands straight on a globe in diameter meet,
That's found just to measure 100 feet;
Suppose that the ball in the air is suspended,
And just half a mile from the earth is extended,
The number of acres of earth there below,
That is hid from his view I desire to know.

N. B. Half a mile to the centre of the ball.

Ans. 2060, 4327+acres.

14. Two men travel round a course of 4 miles in circuit; when they both set off together and travel the same way, the one gains a round of the other in 10 hours; but when they travel contrary ways, they meet every hour; at what rates respectively do they travel?

m. m.
Ans. 2,2 and 1,8 per hour.

15. The sum of two numbers is 1011, the cube root of $\frac{3}{5}$ of the quotient of the greater divided by the less is 7; what are those numbers?

Ans. $1009\frac{403}{1718}$ greater.
$1, \frac{1315}{1718}$ less.

16. Divide $1000 among 3 men, giving the first one-third more than the second wanting $10, and the third half as much as the second and $20 over; I demand each man's share.

Ans. A's share, $\$455\frac{15}{17}$
B's " $349\frac{7}{17}$
C's " $194\frac{12}{17}$.

Proof, 1000

17. A, B, and C company and put in together £3860, A.'s money was in 3 months, B.'s 5 months, and C.'s 7 months; they gained £234, which was so divided, that $\frac{1}{2}$ of A.'s gain was equal to $\frac{1}{3}$ of B.'s, and $\frac{1}{3}$ of B.'s equal to $\frac{1}{4}$ of C.'s; what did each gain and put in?

		£			£
Ans.	A. gained	52	and put in		1400
	B. "	78	"	" "	1260
	C. "	104	"	" "	1200

18. A person has a circular yard, 150 feet in diameter, and wishes a gravel walk of equal width, made round it

within the fence. Required the width of the walk, so that it may occupy a fifth part of the ground.

Ans. 7,918 feet.

19. A gentleman has a garden 100 feet long, and 80 feet broad, and a gravel walk is to be made, of equal width, half round it; what must be the width of the walk, so that it may take up $\frac{1}{4}$ of the ground?

Ans. 11,8975 feet.

20. A, B, and C sold 300 yards of cloth for \$900, and each sold to the amount of \$300; B sold his for one dollar per yard more than A, and C for one dollar more than B; how many yards did each sell?

Ans. { A. sold 135, 481+ / B. " 93, 332+ / C. " 71, 186+ } Yards.

21. Required the dimensions of an oblong garden, containing 3 acres, and bounded by 104 rods of fence.

Ans. 40 rods by 12.

22. Given the slant height of a right cone, standing perpendicularly on a horizontal plane, in latitude 54° 36' North=20 and the diameter of its base=12 feet, to find the time at which, on the 24th of June, the area of the visible part of its shadow is equal to the part of its curved surface which is not enlightened by the direct rays of the sun. Ans. 56 minutes past 6, A. M.
or 4 " " 5, P. M.

23. What is the diameter of a solid globe of glass, which when blown into a hollow globe, until the shell is but $\frac{1}{4}$ of an inch in thickness will be sufficient to contain ten gallons of wine? Ans. 7, 459 inches.

24. The area of a given trapezimm is 20 acres, the diagonal is 5 chains longer than the sum of the perpendiculars, which are in proportion of 3 to 5. Required the dimensions. Ans. 22, 6556+.

25. Charles, Henry and William having a quantity of chesnuts, made the following propositions, viz., says Charles to Henry and William, give me one third of your chesnuts and I shall have 100. Henry says to Charles and William, give me half of yours and I shall have 100. Says William to Charles and Henry, give me one-quarter of

yours and I shall have 100. How many Chesnuts had each boy?

Ans. { Charles had $64\frac{36}{51}$ / Henry " $29\frac{21}{51}$ / William " $76\frac{24}{51}$

26. The sides of a triangle are 32, 40, and 60 rods; how far from each corner must a house be placed to be equally distant from the corners? Ans. 64, 9 rods.

27. A merchant purchased 63 galls. of wine, for $100, but by a leak in the cask a certain quantity was lost; he then sold the remainder for the original cost, and gained a sum per cent. equal to twice the number of gallons lost. Required the number of gallons lost. Ans. 13 gallons.

28. Three merchants join stocks together. The first man's stock was less than the second man's by £13; the second and third man's stock was £175. In trading they gained £48 more than their whole stock; the first man's proportional part of their gain was £78; what was each man's stock and gain?

Ans. { A.'s stock £65 gain £78 / B.'s " 78 " 93, 12s. / C.'s " 97 " 116, 8s.

29. THE PARADOXICAL REEL.

The grandsire with the granddame first the reel began,
Two fathers and two mothers followed on,
Two brothers and two sisters joined the dance,
Two husbands with their wives did then advance,
Two uncles and an aunt the next appear,
With two sons and a daughter in their rear,
Two cousins with a nephew and a niece,
And a young grandson closed the fancy piece.
Soon as the dance was through, they counted o'er,
And five were all the persons on the floor.
Now, I would ask, how hymen could contrive
To make this number count full twenty-five?

EXPLANATION.

A gentleman married a widow who had a daughter, *afterwards* his brother, (a widower,) who had a son

married the daughter; from these five the foregoing relations are made out.

30. Four men have each such a sum of money, which being put together makes 250£s, and if to the first man's money be added £8, it will be just as much as the second man's money decreased by £8, and as much as 8 times the third man's money, and but as much as one-eighth of the fourth man's money. How much had each man?

Ans. A. had £16 $\frac{56}{81}$
B. " 32 $\frac{56}{81}$
C. " 3 $\frac{7}{81}$
D. " 197 $\frac{43}{81}$

Proof. £250

31. A gentleman owning a farm in the form of a circle, whose diameter was 60 chains, in his will gave his six daughters the six largest equal pentagons that could be formed with an angle of each touching the periphery of the circle; to his son the largest hexagon that could be formed about the bars of the pentagon, and the remainder to the widow. How many acres had each?

Ans. Sons, 40, 429
Daughters 26, 876
Widow, 108, 485

32. Required a whole number to which if 8, 19, 32, 47 and 64 be severally added, each sum shall be a square number universally. Ans. 17.

33. Several merchants enter into partnership, each one put into the stock 65 times as many pounds as there were partners; with that stock they traded and gained as many pounds per £100 as there were partners. Now, if £10, 10 shillings be added to and subtracted from their gain, that sum and difference will be £6491, 6 shillings 3 pence. How many merchants were there? Ans. 5 merchants.

34. Divide $3800 in the following manner:

My Polly and Nancy, your shares must be reckoned
In such a proportion to Sue,
That $\frac{1}{10}$ of the first, and $\frac{1}{6}$ of the second
Will equal the third divided by 2.

And further, my daughters, to prove your work true,
For such your proportion must be,
That $\frac{1}{10}$ of Nancy's and $\frac{1}{8}$ of Sue's
Will equal Polly's divided by three.

Ans. { Polly's share, $1165, 427+
Nancy's " 1801, 117+
Sue's " 833, 45+

35. In a triangle containing 100 acres, and the sides equal, the distance from a stoke in the triangle is in this proportion, viz., If $\frac{1}{4}$ of the two greatest distances were added to the shortest, it would make a certain number of chains; if $\frac{1}{5}$ of the greatest and least were added to the other, the sum would be the same; if $\frac{1}{6}$ of the two shortest were added to the greatest, the sum would be the same. The distance from each angle to the stake is required.

Ans. { 30, 55 / 28, 34 / 24, 66 } Nearly.

36. Having evacuated three pieces of canal, containing in the whole 3000 yards; I have $6\frac{1}{2}$ cents per yard for the first, 7 cents for the second, and $7\frac{1}{2}$ cents for the third. When I received payment, I found the pieces amounted to equal sums of money; how many yards did each piece contain?

Ans. { 1st piece contained 1073, 253
2d " " 996, 592
3d " " 930, 153

37. There are four wheels of the following dimensions, viz: The first 10 feet in circumference, the 2d 20, the third 30, and the fourth 40; they each have a black spoke on which they stand. It is required to know how far each wheel shall roll, to have them all stand on the same black spoke, as at the beginning? Ans. 120 feet.

38. If a solid globe of glass at the furnace, whose diameter is 8 inches, be blown into a hollow globe, till the shell is but $\frac{1}{5}$ of an inch in thickness, what will then be its diameter, and how much wine will it hold?

Ans. 20,655 inches diameter.
18,83 gallons.

39. On the 4th of July a pole was erected,
Composed of six pieces, and nicely connected;
Two feet and six inches it measured around,
At the place where it stood on the top of the ground.
The form was a cone, in surface complete;
The heighth of the same was twice 60 feet.
What length of inch ribbon procured at the shop,
Will wind round the pole from bottom to top,
And have it lay smooth, and plain to be seen,
By leaving a space of 5 inches between?

Ans. 300 feet.

40. A gentleman owning a farm in the form of a circle, bequeathed to his five sons, the five largest circles that could be formed within, and touching the periphery of the circular farm. To his daughters he gave that portion of land at the centre contained between the peripheries of the five equal circles, which was 40 acres, and the remainder to the widow. I demand each son and widow's share.

Ans., son's, 57,92 acres.
widow, 93,05 "

41. A gentleman at his decease left a widow, son and daughter, and annexed to his will was a sealed packet with directions for it not to be opened till the son and daughter had arrived at lawful age. When they were of age, the packet was opened, and found to contain $1000, to be disposed of as follows; If the son should marry before arriving at age and the daughter not, he was to have three parts and the mother one. If the daughter was to marry before arriving at age and the son not, the mother was to have three parts and the daughter one. It so happened that both son and daughter married. Query, how is the $1000 to be divided?

Ans. { Son 9 parts equalling, $692 4/13
Mother 3 " " 230 10/13
Daught. 1 " " 67 12/13

$1000 Proof.

42. How many head of cattle may come from a heifer calf in 20 years, provided they are all of the feminine gender, and each one to have a calf when she becomes 3 years old, and after that have a calf every year?

Ans. 1278 head.

43. The product of two numbers is 3802,5; they are in the ratio of 8 to 5; what are those numbers?

Ans. 78 and 48,75.

43. Required the diameter of a circle which shall just enclose six of the largest equal circles that can be formed within it, and have 50 acres about the centre between the peripheries of the equal circles. Ans. 41, 6168 chains.

44. In an oblique angled triangle there is given the product of the two sides 186, their difference 3,5, and the shortest side is to the base in the ratio of 4 to 7. The sides are required.

Ans. $\left\{\begin{matrix} 15,5 \\ 12 \\ 6\frac{6}{7} \end{matrix}\right\}$ Sides.

45. There are two numbers, the product of whose multiplication is 79, 625, and that of their cubes is 2112, 890625. What are the numbers?

Answer, 6, 5
12, 25

46. The diameter of a circle is 40 chains. Required the length of the sides of ten of the largest equal pentagons that can be formed within it, with an angle of each touching the periphery of the circle, and leaving a decagon at the centre, whose side shall be equal to the side of each pentagon? Ans. 6, 5 chains.

47. A gentleman has a garden in the form of an equilateral triangle, containing half an acre; the soil being low and naturally moist, wishes to raise it, by heaping earth upon it. How wide and deep must a ditch be dug on the outside of the triangle, but within the limits of the half acre, to yield earth sufficient to raise the ground plot one foot, the width and depth being equal?

Ans. 5 feet 4 inches.

48. Says A. to B., if I had 5 of your crowns, I should have twice as many as you would have left; and says B. to A., if I had 3 of yours, I should have four times as many as you. How many had each?

Ans. A. had $6\frac{3}{7}$, B. had $10\frac{5}{7}$.

49. A country spark addressed a charming she,
In whom all lovely features did agree;
But he not skilled, as you may now presage,
Was too solicitous to know her age.

The lady smiled at this preposterous rule,
But condescends to satisfy the fool;
Made him this answer, with a generous air,
A lofty smile, peculiar to the fair:
My age is such if multiplied by three,
And $\frac{2}{7}$ of that product trebled be,
The square root of $\frac{2}{9}$ of that is four;
So fare ye well, you are to know no more,
Your fond impertinence has caused this rage,
'Tis clownish, sir, to ask a woman's age.

Ans. 28 years.

50. A gentleman bequeathed to his six sons and widow, a circular piece of land, containing 785, 4 acres, in the following manner, viz.: to his eldest three each the largest circle that can be inscribed within the circular tract; to his widow, the piece at the centre and bounded by the three equal circles; the three remaining pieces to his younger sons. I demand each ones' share.

Ans. { Eldest sons' share, 169, 167716
Widow's share, 8, 702423
Younger sons' share, 89, 731476

51. A general forming his army into a square, finds he has 284 soldiers over and above a square; but increasing each side with one soldier, he wants 25 to fill up a square. How many soldiers had he? Ans. 24000 men.

52. Two men, A. and B., purchased 200 oranges, and gave $10 for them, in the payment of which each paid $5. Now, says A. to B., give me my choice in the oranges, and I will allow 2 cents per orange more than you do. Required how many each had, and at what price per orange?

Ans. { A. had 80, 7417+at 06,192+
B. " 119, 2582+at 04,192+

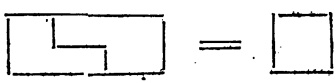
53. A. B. and C. purchased a block of land, containing 4000 acres, at $3,75 per acre; a canal runs through the S. E. section of it; and A., willing to avail himself of the accommodation thereof, proposes to B. and C. to pay 75 cents per acre more for this section than they, provided they will allow him his proportion in it; agreed. Now, before B. and C. make a division; a rail road has been commenced through the N. W. part of the block, in con-

sequence of which, B. proposes to C. to pay $1,25 per acre more than he for his choice, (agreed also.) Now, admitting that each paid one-third of the original purchase, and none give or receive cash afterwards, how must the land be divided to answer these conditions, and what will each man's proportion stand him in per acre?

	A	R	P		
Ans. A.	1167	3	31,8	at	$4,28,1
B.	1172	3	5,76	"	4,26,335
C.	1659	1	2,44 3,	"	01,335
	4000				

54. What is the side of that equilateral triangle, whose area costs as much for paving, at 8 pence sterling a foot, as the pallisading of the three sides did at a guinea per yard? Ans. 72,746 feet.

55. A captain gives to one of his men a plank 9 by 16 inches, with orders to make a lid 12 inches square, and only to cut the plank in two pieces. The man being ignorant of lines, would be obliged to any one to draw a plot, how the plank is to be cut.



56. It is required to find the thickness of the lead in a pipe of an inch and $\frac{1}{4}$ bore, which weighs 14 lbs. per yard in length, the cubic foot of lead weighing 11325 ounces. Ans. $\frac{20737}{100000}$ inches.

57. Having surveyed an isoseles triangle, whose equal sides are ten rods each, I find if I either add or subtract 2 rods to or from the other side in each case, the area will be 2 rods less in the calculation than the true content. Required the side. Ans. 14 rods.

58. If a heavy sphere, whose diameter is 4 inches, be let fall into a conical glass full of water, whose diameter is 5 and altitude 6 inches. It is required to determine how much water will run over. Ans. 26,272 cubic in.

59. The dimensions of the sphere and cone being the same as in the last question, and the cone only $\frac{1}{2}$ full of water. Required what part of the axis of the sphere is immersed in the water. Ans. ,546 pts.

60. The cone being still the same, and $\frac{1}{3}$ full of water. Required the diameter of a sphere which shall be just covered by the water. Ans. 2, 445+.

61. A certain man disposed by will
A circular piece of land,
To his dear wife and daughters three,
As here below doth stand.
The circle was precisely such
When measured through the centre,
By Gunter's chain it did contain,
In numbers four and twenty;
His daughters' portions were alike,
In the aforesaid ground;
They each must have a circular piece,
As large as can be found.
And the remainder of the land
Unto his wife he willed,
And left it with a faithful hand,
To see it all fulfilled.
At £20 an acre just,
This land must valued be.
Now tell me what's the widow's worth,
Likewise the daughters three.

		Acres.	
Ans.	Daughters' share,	29, 232, equals	£584, 640
	Widow's "	16, 00704, "	320, 140+.

62. Supposing there is a circle 20 feet in diameter, how large a trench of equal breadth and depth will it take to fill this circle in the form of a half globe, the trench to be dug around the circle? Ans. 5, 148689+feet.

63. If 6 oxen or 10 colts can eat 21 acres of pasture in 14 weeks, and 10 oxen and 6 colts can eat 45 acres of similar pasture in 20 weeks, the grass growing uniformly, how many sheep will eat 240 acres in 40 weeks, admitting that 1134 sheep can eat the same quantity as 12 oxen and 22 colts? Ans. 3472 sheep.

64. If 9 gentlemen or 15 ladies will eat 17 apples in 5 hours, and 15 gentlemen and 9 ladies can eat up 47 apples of a similar size in 12 hours, the apples growing uniformly, how many boys will eat up 360 apples in 60 hours, admit-

ting that 120 boys can eat the same number as 18 gentlemen and 26 ladies? Ans. 642+boys.

65. A certain house standing on a plain is 28 feet wide, and 35 feet high, the top of the roof being 15 feet higher than the feet of the rafters. It is required to find the length of a ladder that will just reach from the ground to the top of the house, and lie on the roof exactly parallel to it. Ans. 47, 8+feet.

66. A note was given for $35, dated 3d day of 4th month, 1827, payable one year after date, and the conditions of payment were these: provided one-half of the value of the said note be paid 6 months after date, that the remainder should become due 18 months after date, and so in proportion to the value of the payments and the time when paid. On said note were the following payments, viz., $10 10 days after date, $10 the 21st day of 7th month, 1827, and $5 the 8th of third month, 1828. Required the time after the date of the note, that the remainder shall become due. Ans. 988½ days.

67. A landed man two daughters had,
And both were very fair;
He gave to each a piece of land,
One round, the other square.
For 20 shillings an acre just,
Each piece its value had;
But when they parted with the same
It made their hearts full glad;
For, by a contract fairly done,
The price of each was made,
The shillings that encompassed each,
For each exactly paid.
If across a shilling be an inch,
The which is very near,
The query is, which sold for most,
The round piece or the square?

Ans. { Round piece, 3941225,+shill.
Square piece, 5018112,+shill.

68. How deep must I saw into a round log, 36 inches in diameter, to cut it ⅓ off? Ans. 13,+inches.

69. Suppose a crown that shall weigh 60 lbs. is to be

made of gold, brass, iron and tin, mixed together in such proportions that the weight of the gold and of the brass together may be 40 lbs.; the joint weight of the gold and of the tin 45 lbs., and the joint weight of the gold and of the iron 36 lbs. How much of those four metals must be taken?

Ans. $\begin{cases} 30\frac{1}{2} \text{ pounds gold,} \\ 9\frac{1}{2} \text{ " brass,} \\ 5\frac{1}{2} \text{ " iron,} \\ 14\frac{1}{2} \text{ " tin.} \end{cases}$

70. Suppose two towers standing on a common level; the one is 280 feet and the other 210 feet high; the whole distance between the towers 225 feet. I would know the length of a ladder that will reach the top of each without moving the foot, and also the distance of the ladder from the foot of each tower.

Ans. $\begin{cases} 282,34 \text{ length of the ladder.} \\ 188,72 \text{ from one tower.} \\ 36,28 \text{ from the other.} \end{cases}$

71. The discounting of a bill which at a certain rate per cent. per annum came to £5, 12 shillings, and would at one per cent. more have cost £6, 6 shillings, and at one per cent. less no more than £4, 18 shillings. The value of the bill, time, when due, and rate of interest is required.

Ans. Rates of interest 7, 8, 9, and the price and time are any two numbers whose product equals 1400 shillings.

72. A man had a stone which he kept as a weight for his scales, which weighed 1093 lbs.; he broke it into 7 pieces, after which he could by its assistance not only weigh 1093 lbs, but every pound under 1093. What was the weight of each piece?

Ans. 1, 3, 9, 27, 81, 243, 729,=1093.

73. Required two numbers, such that the lesser number may be contained in the greater twice, with a remainder; this remainder in the lesser twice, with a remainder; this new remainder in the first remainder twice, with a remainder, and so on, every remainder to be found twice

with a remainder, till the eleventh division, in which the remainder is to be a rational cube.

Ans. { Divisor 70693
Dividend 170668

74. To pay a certain number of workmen at the rate of £3 per man, £8 is wanting to the person who employs them; but on giving them £2 each he has £3 left. How many workmen were there? Ans. 11 men.

75. Required in what time a cistern of 200 cubic feet will be filled by three pipes, the first of which can fill 9 cubic feet in $2\frac{1}{2}$ days; the second 15 cubic feet in $3\frac{1}{3}$ days, and the third 19 cubic feet in $5\frac{1}{4}$ days.

Ans. $17\frac{163}{2461}$ days.

76. If a person with an air balloon ascends vertically from the city of Hudson, to that heighth that he may just see the top of a flag-staff hoisted on the top of the city hall, in New York, appear in the horizon. I demand his heighth above the surface of the earth, supposing the circumference to be 25000 miles, and the distance between Hudson and New York 150 miles, and the flag erected 100 feet from the ground. Ans. 2,3576 miles.

77. A man in the centre of a circular field, containing ten acres, starts for the circumference, and after walking a certain distance, turns, making an angle of 45 degrees. The whole distance walked was 40 rods; how far did he walk before he made the turn? Ans. 11, 03 rods.

78. Three magazines containing three sorts of grain each; the first contains of rye 30 bushels, of barley 20 bushels, and of wheat 10 bushels, and costs £11, 10 shillings. The second contains of rye 15 bushels, of barley 6 bushels, and of wheat 12 bushels, and costs £6, 18 shillings. And the third contains of rye 10 bushels, of barley 5 bushels, and of wheat 4 bushels, and costs £3, 15 shillings. I demand the price of the rye, barley, and wheat, per bushel.

Ans. { Rye 4 shillings.
Barley 3 "
Wheat 5 "

79. Two travellers set out at the same time; the one from Dublin, and the other from Londonderry; the former *for Londonderry*, the latter for Dublin. When they met

and had computed their journey, it was found that the former had travelled 30 miles more than the latter, and that at their rate of travelling, the former expected to reach Londonderry in 4 days, and the latter to reach Dublin in 9 days. The distance between Dublin and Londonderry is required. Ans. 150 miles.

80. Two masons, A. and B., jointly perform a piece of work in 12 days; now, if the sum of the days [redacted] which they could each have separately performed the same, be multiplied by the days in which A. alone (he working quicker than B) could have done it, the product will be 1000. In what time could each do it?

Ans. A. in 20, B. in 30 days.

81. If the side of an equilateral triangle pyramid is 24 inches, what is the diameter of the smallest globe from which it could be made? Ans. 26, 91 inches.

82. A sum of £120, 5 shillings was lent on condition that the principal and interest at 6 per cent. per annum should be discharged in 7 equal payments, one at the end of every year, and that at each payment, the interest then due should be cleared, and the remainder by which such payment exceeds the interest, applied to reduce the principal. The value of the payment is required.

Ans. £21, 10 shill. $9\frac{1}{2}$ pence.

83. What is the length of the side of a cubic box, which contains its largest inscribed globe and one bushel to fill the vacancies? Ans. 16, 526 inches.

84. A messenger being departed 9 hours from a certain place, travelling at the rate of 5 miles in 2 hours, another messenger is sent after him, who travels at the rate of 11 miles in 3 hours. It is required to find what number of miles the second messenger will ride before he overtakes the first? Ans. 70 $\frac{5}{7}$ miles.

85. The radius of a circle is 64 chains. Required the length of the side of the 8 largest pentagons that can be formed within its periphery, leaving an octagon at the centre, whose side is equal to that of either of the pentagons. Ans. 23, 307 chains.

86. The age of a man, his wife and son, all added together, make 76 years; if the man's age be added to his son's, the sum would equal the wife's and 20 years over.

but if the wife's and son's were added, it would equal the father's age and 4 years. What was the age of each?

Ans. { Son's 12 years. Wife's 28 " Father's 36 "

87. A., B. and C. enter into partnership. A puts in $100 for 14 months, and draws $112 gain. B. puts in —— for 12 months, and draws $128 gain. C. puts in $100 for ——, and draws $116 gain. Required B.'s stock, and C.'s time.

Ans. { B.'s stock 117\frac{5}{7}$ C.'s time 18$\frac{2}{3}$ months.

88. A vinter has a cask of wine containing 500 gallons, of which he drew 50 gallons, and then filled it up with water, and did so 5 times. I demand how much wine and water there was left in the cask.

Ans. { 295$\frac{49}{200}$ gallons of wine. 204$\frac{151}{200}$ gallons of water.

89. The diameter of a circle is 40 chains. Required the length of the sides of ten largest equal pentagons that can be formed within it, with an angle of each touching the periphery of the circle, leaving a decagon at the centre, whose sides shall be equal to the side of each pentagon.

Ans. 6$\frac{1}{2}$ chains.

90. Suppose the frustrum of a right pyramid to be 4 feet square at the base, and one foot at the top, and the slant heighth 20 feet, and a rope 2 inches thick to be wound round it, so as to cover its sides from bottom to top. How long is the rope? Ans. 1280 feet.

91. A. B. and C. make a company, and put in £3860. A.'s money was in 3 months, B.'s 5 months, and C.'s 7 months; and they gained £234, which was so divided that $\frac{1}{2}$ of A.'s gain was equal to $\frac{1}{3}$ of B.'s, and $\frac{1}{3}$ of B.'s to $\frac{1}{4}$ of C.'s. What did each gain, and put in?

Ans. { A.'s stock £1400 gain £52 B.'s " 1260 " 78 C.'s " 1200 " 104

92. A gentleman owning a tract of land in the form of a circle, containing 785, 4 acres, bequeathed to his 10 daughters the ten largest pentagons that could be formed within it, with an angle of each touching the periphery of the circle; to his son he gave the largest decagon that could be formed about the basis of the pentagon, and the remainder to his widow. Required each ones' share.

Ans. { Sons' 203, 075 / Daughter's 45, 409 / Widow's 128, 235 } acres.

93. A vinter has a cask of wine containing 500 gallons, of which he drew 50 gallons, and filled up the cask with water; he drew the next time 40 gallons, the next time 30, the next time 20, and the next time 10 gallons, still filling up the cask with water as he drew. I demand how much wine and how much water is in the cask.

Ans. { Wine $366\frac{3804}{31250}$ / Water $133\frac{27448}{31250}$ } gallons.

94. A. B. and C., with their wives P. Q. and R., went to the market to buy sheep; each man and woman bought as many sheep as they gave shillings for each sheep; A. bought 23 sheep more than Q., and B. bought 11 more than P., also each man laid out 63 shillings more than his wife. Which two persons were husband and wife?

Ans. { 32=A. and R.=31 / 12=B. " Q.= 9 / 8=C. " P.= 1 }

95. A tree 120 feet in heighth, stood upon an eminence, but being partly broken off at a certain distance from the ground, and the top falling down a declivity considerably lower than the foot of the tree, but resting upon the stump, the distance from the foot to the top of the tree when down was 90 feet, and a line drawn from the foot, at a right angle with the perpendicular stump, to intersect the part broken off was 40 feet. Question, how high was the tree broken above the ground? Ans. 21,6981+feet.

96. Four men travelling together, found a purse of shillings only, out of which every one took a number at an

adventure; afterwards, by comparing their number together, they found, if the first took 25 shillings from the second, it would make his number equal with what the second had then left; if the second took 30 shillings from the third, his money would then be tripple to what the third had left; and if the third took 40 shillings from the fourth, his money would then be double what the fourth had left; lastly, the fourth taking 50 shillings from the first, he would then have three times as much as the first had left and 5 shillings more. What was each person's share?

Ans. { 1st, 100 shillings. / 2d, 150 " / 3d, 90 " / 4th, 105 "

97. Suppose two hollow globes to be one inch in thickness, and of such dimensions, that if the smaller globe be put into the larger one, it would exactly fill it; these globes when separate will contain 2000 cubic inches of fluid. Now, suppose that the exterior surface of the larger globe be divided by the usual number of parallel lines found on artipecal globes used by geographers, and likewise to be divided in the same manner as the globes are divided. The question is, what is the distance around this last mentioned globe at the 74 parallel of latitude?

inches.
Ans. { 15,3264 Dia. of greater. / 13,2745 Cir. at 74 parallel.

Rule. As radius is to Cir., so is Co Sine to the required circumference.

98. There are two numbers, if the greater is added to its square, and from this sum we subtract the square of the lesser, the remainder is 94. But the square of the lesser being added to the lesser, the sum is equal to twice the greater. Required the numbers. Ans. 10 and 4.

99. What must be the diameter of a vessel whose concavity is in the form of a sphere to contain 500 wine gallons. Ans. 60,422 inches.

100. Two porters agreed to drink off a quart of beer *between them,* at a draught each; the first drank till the

surface of the liquor touched the opposite edge of the bottom, and then gave the remaining part to the other. What was the difference of their shares, supposing the cup was the frustrum of a cone, the depth being 6 inches, the diameter at the top 4 inches, and at the bottom 5 inches?

Ans. 15,89 cubic inches.

101. A cooper wants a cistern, to contain 1500 wine gallons, the heighth to be 6 feet, and the difference of the diameters to be 6 inches. Required the diameters.

Ans. 81,259 and 75,259 inches.

102. Suppose three lots of ground, of equal area, the first a pentagon, the second a hexagon, and the third a heptagon; each lot is enclosed with a board fence two boards high, each board fifteen feet long, and the whole number of boards enclosing the three lots is equal to the whole number of acres. Required the side of each lot.

chains.

Ans. { 250,61 pentagon.
203,94 hexagon.
172,44 heptagon.

103. An eagle conscious of superior might,
Straight up through boundless ether winged his flight,
When looking downwards through the wide expanse,
One-third the earth's curve surface caught his glance.
He now descends and asks the nations all,
The heighth he soared from the terrestrial ball?
Would likewise know how far his piercing sight
Extended from the summit of his flight?

Ans. To the heighth of the earth's diameter.

104. The area of a certain piece of land contained between three equal circles, whose peripheries just touch each other, is 2 acres. What is the diameter of that circle which will just enclose the three? Ans. 47,98646 chains.

105. A and B purchased a valuable farm, containing 900 acres of land, at the rate of $2 per acre, which they paid equally between them; but on dividing the same, A got that part of the farm which contained the best improvements, and agreed to pay 45 cents per acre more than B. How many acres had each?

Ans. { A's share 400 acres.
B's " 500 "

106. Says A to B and C, give me $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{11}$, and $\frac{1}{20}$ of your money, and I shall have \$50 more than I have at present. Says B to A and C, give me $\frac{1}{2}$, $\frac{1}{8}$, and $\frac{1}{16}$ of your money, and I shall have \$50 more than I have at present. Says C to A and B, give me $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{12}$ and $\frac{1}{50}$, and my money will be doubled. How much had each?

Ans. { A had \$40,67+
B " 36,98+
C " 32,05+

107. Suppose an ox horn to be two feet and a half long, and nine inches in circumference at the but, and 2 inches and a half at the tip; the horn being hollow, $\frac{1}{2}$ an inch thick, how much wine will it take to fill it, and how much gold would it take to overlay it half an inch thick?

Ans. { $\frac{24,\ 6}{231,}$ gallons.
102, 1 solid inches.

108. Required the circumference of two circles, the sum of whose diameters, if increased by $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$, would amount to 5 times the diameter of the smaller circle, and if the square of their sum be increased by $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$, would amount to 90 times their diameters. Now, a ditch of equal breadth and depth is to be dug around the greater circle, yet within the limits of its circumference, to yield earth sufficient to form each circle into a half globe. Require the width and depth of the ditch.

Ans. { Diameter 28 and 20
6,61 feet.

109. A curious man of high degree
A garden would lay out,
When done, intending it should be
Eliptically about.
The size of it was, if I am right,
An acre full content;
Its wall or fence, when finished quite,
In this proportion went,

So that the length unto the breadth
Should most exactly be,
Nicely curious in the width,
As two is unto three;
Now, this is all I do demand
Of any, who can tell,
What was the breadth of this same land,
And length also as well?

Ans. { 11, 653 rods breadth.
17, 479 transverse Dia.

110. Suppose three lots of land, of equal area, one of which is circular, the second square, and the third in the form of an equilateral triangle; each lot is enclosed with a four rail fence, the rails being 12 feet in length, and the whole number of acres in the three lots equal to the number of rails. Required the area of each lot, and the number of rails enclosing it. Ans. 228970,75 acres.

111. What is the difference between six dozen dozen, and half a dozen dozen? Ans. 792.

112. What number multiplied by 6 will make 2058? Ans. 343.

113. A gentleman went to sea at 17 years of age; 8 years after he had a son born, who died at the age of 35; after whom the father lived twice 20 years. How old was the father at his death? Ans 100 years.

114. What number is that, which being multiplied by 15 the product will be $\frac{3}{4}$? Ans. $\frac{1}{20}$.

115. What decimal is that, which being multiplied by 15 the product will be ,75? Ans. '05.

116. What number is that, which being divided by $\frac{2}{4}$ the quotient will be 21? Ans. $15\frac{3}{4}$.

117. What number is that, which multiplied by $\frac{2}{3}$ produces $\frac{1}{4}$? Ans. $\frac{3}{8}$.

118. A farmer carried a load of produce to market: he sold 780 pounds of pork, at 6 cents per pound; 250 pounds of cheese, at 8 cents per pound; 154 pounds of butter, at 15 cents per pound. In pay he received 60 pounds of sugar, at 10 cents per pound; 15 gallons of molasses, at 42 cents per gallon; $\frac{1}{2}$ barrel of mackerel, at $3.75; 4 bushels of salt, at $1,25 per bushel; and the *balance in money*. How much money did he receive?

Ans. 68,883

119. A man exchanges 760 gallons of molasses, at 37½ cents per gallon, for 66½ cwt. of cheese, at $4 per cwt.; how much will be the balance in his favor? Ans. $19.

120. Jones bought 84 yards of cloth at $1,25 per yard; how much did it come to? How many bushels of wheat, at $1,50 per bushel, will it take to pay for it?

Ans. 70 bushels.

121. A man sold 342 pounds of beef, at 6 cents per lb., and received his pay in molasses, 37½ cents per gallon, how many gallons did he receive? Ans. 54 ·72 galls.

122. A man exchanged 70 bushels of rye, at 92 cents per bushel, for 40 bushels of wheat at $1,37½ per bushel, and received the balance in oats at 40 cents per bushel; how many bushels of oats did he receive?

Ans. 23½ bushels.

123. How many bushels of potatoes, 1s. 6d. per bushel, must be given for 32 bushels of barley, 2s. 6d. per bushel?

Ans. 53⅓ bushels.

124. How much salt, at $1,50 per bushel, must be given in exchange for 15 bushels of oats, at 2s. 3d. per bushel?

Ans. 3¾ bushels.

125. How much wine, at $2,75 per gallon, must be given in exchange for 40 yards of cloth, at 7s. 6d. per yard?

Ans. 18$\frac{2}{11}$ gallons.

126. A had 41 cwt. of hops, at 30s. per cwt., for which B gave him £20 in money and the rest in prunes, at 5d. per pound; how many prunes did A receive.

Ans. 17 cwt. 3 qrs. 4 lbs.

127. A has linen cloth worth 30 cents per yard; but, in barter he will have 35 cents per yard; B has broadcloth worth $3,75 ready money; at what price ought the broadcloth to be rated in bartering with A?

Ans. $4,37½.

128. If cloth, worth 2s. per yard, cash, be rated in barter at 2s. 6d., how should wheat, worth 8s. cash, be rated in exchange for the cloth? Ans. 10 shillings.

129. If 4 bushels of corn cost $2, what is it per bushel?

Ans. 50 cts.

130. If 9 bushels of wheat cost $13,50, what is it per bushel? $1,50.

131. If 40 sheep cost $80, what is tha

132. If 3 bushels of oats cost 7s. 6d., how much are they per bushel? Ans. 2s. 6d.

133. If 22 yards of broadcloth cost £21 9s., what is the price per yard? Ans. 19s. 6d.

134. At 50 cents per bushel, how much corn can be bought for $2,00? Ans. 4 bushels.

135. A man, having $100, would lay it out in sheep, at $2,50 per head, how many can he buy?

Ans. 40 sheep.

136. If 20 cows cost $300, what is the price of 15 cows?

Ans. $225.

137. If 7 men consume 24 pounds of meat in one week, how much would 10 men consume in the same time?

Ans. 34$\frac{2}{7}$ lbs.

138. If I pay $6 for the use of $100, how much must I pay for the use of $75. Ans. $4,50.

139. What premium must I pay for the insurance of my house against loss by fire, at the rate of $\frac{1}{2}$ per cent, if my house be valued at $2475? Ans. $12,37$\frac{1}{2}$.

140. What will be the insurance, per annum, of a store and contents, valued at $9876,40 at $1\frac{1}{2}$ per cent?

Ans. $148,146.

141. What commission must I receive for selling $478 worth of books, at 8 per cent? Ans. $38,24.

142. The births in a certain town were 475, and the proportion 13 boys to 12 girls, what was the number of each? Ans. 247 boys, 228 girls.

143. How many yards of carpet, yard wide, will cover a floor 25 feet long and 18 feet wide? Ans. 50 yards.

144. How many trees, 4 feet apart every way, may grow in a nursery of one acre of ground?

Ans. 2722 trees.

145. If a ship of 350 tons, chartered at 3s. a ton per month, deliver a cargo of 600 tons, what is the real rate per ton? Ans. 1s. 9d.

146. A farmer raised 43 tons 11 cwt. 3 qrs. 14 lbs. of carrots on 1 acre, 1 rood, and 25 perches. What was it per acre? Ans. 31 tons.

147. There are two numbers in proportion as 3 to 11, the greater is 3267, what is the sum of both?

Ans. 4158.

148. The Chinese wall is said to be 1200 miles in length, averaging 18 feet high, and 18 feet thick, how many solid fathoms does it contain? Ans. 9,504,000 fathoms.

149. Suppose a steamboat $\$110\frac{3}{4}$ per share, cost $\$25472,50$, and that $\frac{62}{230}$ of it sold for $\$5725$, was there a gain or loss by the sale, and how much?

Ans. $\$1141,50$ loss.

150. A pile of wood 84 feet 6 inches long, 22 feet 7 inches high, 23 feet 10 inches wide, is sold at $\$3,26$ per cord, what is the amount? Ans. $\$1158,32$.

151. Required the cost of a lot of land 62 feet $11\frac{3}{4}$ inches long, and 27 feet $3\frac{1}{2}$ inches wide, at $\$1.80$ per square foot? Ans. $\$3093,96$.

152. A of Boston has in his hands $\$500$ due to M of Baltimore, for net proceeds of his cotton, this he remits to M per bill on D in his favor when bills on Baltimore are 2 per cent. discount. Require the amount of the bill?

Ans. $\$510,20$.

153. Suppose $\$984,37\frac{1}{2}$ was paid in New Orleans for a bill on New York, when the advance was 5 per cent.; what was the bill drawn for? Ans. $\$937,50$.

154. If 33865 feet of land sold in Boston in 1824 for $\$403840,12\frac{1}{2}$, how much is it per foot, and what would be the rate per acre in federal money, and also in sterling money? Ans. $\$11,92\frac{1}{2}$ per foot.

$\$519,453$ per acre.

Equal to £116,876, 18, 6 sterling.

155. How much land, at $\$250$ per acre, must be given in exchange for 360 acres, at $\$3,75$ per acre?

Ans. 540 acres.

156. A merchant bought a quantity of goods for $\$734$, and sold them so as to gain 21 per cent.; for how much did he sell his goods? Ans. $\$888,14$.

157. A merchant bought a quantity of goods at Boston for $\$500$, and paid $\$43$ for their transportation, he sold them so as to gain 24 per cent. on the whole cost; for how much did he sell them? Ans. $\$673,32$.

158. Bought a quantity of books for $\$64$, but for cash a discount of 12 per cent was made; what did the books cost? Ans. $\$56,32$.

159. Bought a book, the price of which was marked

$4,50, but for cash the bookseller will sell it at 33⅓ per cent. discount; what is the cash price? Ans. $3,00.

160. A merchant bought a cask of molasses, containing 120 gallons for $42; for how much must he sell it to gain 15 per cent; how much per gallon?

Ans. to the last $,40½.

161. A merchant bought a cask of sugar containing 740 pounds, for $59,20; how must he sell per pound to gain 25 per cent? Ans. $,10 cts.

162. What is the interest, at 6 per cent., of $71,02 for 17 months 12 days? Ans. $6, 178+.

163. What is the interest of $487,003 for 18 months, at 6 per cent? Ans $43,83+.

164. What is the interest of $8,50 for 7 months?

Ans. $,297½.

165. What is the interest of $1000 for 5 days?

Ans. $, 83⅓ cts.

166. What is the interest for 50 cents for 10 years?

Ans. 30 cts.

167. What is the interest of $84,25 for 15 months and 7 days, at 7 per cent.? Ans. $7,48$\frac{6}{10}$.

168. What is the interest of $154,01 for 2 years, 4 months and 3 days, at 5 per cent? Ans. $18,032.

169. What sum, put at interest at 6 per cent., will, in 2 years and 6 months, amount to $150?

Ans. $130,434+.

170. I owe a man $475,50, to be paid in 16 months, without interest; what is the present worth of that debt, the use of the money being worth 6 per cent?

Ans. $440, 277+.

171. What is the present worth of $1000 payable in 4 years and 2 months, discounting at the rate of 6 per cent?

Ans. $800.

172. A merchant bought articles to the amount of $500, and sold them for $575, what did he gain per cent.?

Ans. 15 per cent.

173. A merchant bought cloth at $3,50 per yard, and sold it at $4,25 per yard, how much did he gain per cent?

Ans. 21$\frac{3}{7}$ per cent.

174. A man bought a cask of wine, containing 126 gallons, for $283,50, and sold it out at the rate of $2,75 per

gallon; how much did he gain on the whole; how much per gallon and how much per cent?

Ans. whole gain $63; per gallon $, 50, which is $22\frac{2}{9}$ per cent.

175. If $100 gain $6, in 12 months, in what time will it gain $14? Ans. 24 months.

176. In what time will $54,50, at 6 per cent., gain $2,18? Ans. 8 months.

177. 20 men built a certain bridge in 60 days, but it being carried away in a freshet, it is required how many men can rebuild it in 50 days? Ans. 24 men.

178. If a field will feed 7 horses 8 weeks, how long will it feed 28 horses? Ans. 2 weeks.

179. If a field, 20 rods in length, must be 8 rods in width to contain an acre, how much in width must be a field, 16 rods in length to contain the same?

Ans. 10 rods.

180. If I purchase for a cloak 12 yards of plaid $\frac{5}{8}$ of a yard wide, how much bocking, $1\frac{1}{2}$ yards wide, must I have to line it? Ans. 5 yards.

181. If a man earn $75 in 5 months, how long must he work to earn $460? Ans. $30\frac{2}{3}$ months.

182. A owes B $450, but A not being worth so much money, B agrees to take 75 cents on the dollar; what sum must B receive for the debt? Ans. $405.

183. A cistern, whose capacity is 400 gallons, is supplied by a pipe which lets in 7 gallons in 5 minutes, but there is a leak in the bottom of the cistern which lets out 2 gallons in 6 minutes, supposing the cistern empty, in what time would it be filled?

Ans. 6 hours 15 minutes.

184. A ship has a leak which will fill it so as to make it sink in 10 hours, it has also a pump which will clear it in 15 hours, now if they begin to pump when it begins to leak, in what time will it sink? Ans. 30 hours.

185. A cistern is supplied by a pipe which will fill it in 40 minutes; how many pipes of the same bigness will fill it in 5 minutes? Ans. 8.

186. Suppose I lend a friend $500 for 4 months, he promised to do me a like favor; some time afterward I *have need of* $300, how long may I keep it to balance the *former favor*? Ans. $6\frac{2}{3}$ months

187. Suppose 800 soldiers were in a garrison with provisions sufficient for 2 months; how many soldiers must depart, that the provisions may serve them 5 months?

Ans. 480.

188. If my horse and saddle are worth $84, and my horse be worth 6 times as much as my saddle, pray what is the value of my horse? Ans. $72.

189. Bought 45 barrels of beef at $3,50 per barrel, among which are 16 barrels, whereof 4 are worth no more than 3 of the others; how much must I pay?

Ans. $143,50.

190. Bought 126 gallons of rum for $110, how much water must be added to reduce the first cost to 75 cents per gallon? Ans. $20\frac{2}{3}$ gallons.

191. A thief having 24 miles start of the officer, holds his way at the rate of 6 miles an hour; the officer pressing on after him at the rate of 8 miles an hour; how long before he will overtake the thief? Ans. 12 hours.

192. In an orchard of fruit trees, $\frac{1}{2}$ of them bear apples, $\frac{1}{4}$ pears, $\frac{1}{6}$ plums, 60 of them peaches, and 40 cherries; how many trees does the orchard contain?

Ans. 1200 trees.

The above example and others are usually wrought by the rule called Position, but they are more easily solved on general principles.

193. A and B commenced business with equal sums of money; A gained a sum equal to $\frac{1}{5}$ of his stock, but B lost $200, and then had only half as much as it, what was the original stock of each? Ans. $500.

194. By Ferguson's tables of specific gravities a cubic inch of pump water weighs 9,26 drams, and it is found on trial that a gallon of 231 cubic inches of cider weighs 10 ounces and 10 drams more than water; what then should the liquor in a barrel of $31\frac{1}{2}$ gallons weigh?

Ans. $28\frac{3}{4}$ pounds.

If the gallon be taken at 9 pounds it will answer for common purposes.

195. There are 7 chests of drawers, in each of which there are 18 drawers, and in each of these there are 6 divisions, in each of which is £16 6s. 8d.; how much money is there in the whole? Ans. £12348.

196. Bought a piece of cloth for $50, at 75 cents per yard, and sold $\frac{1}{2}$ of it at 10 per cent. gain, the remainder at 15 per cent. loss; what was the loss on the whole piece?

Ans. $1,25.

197. A hare starts 12 rods before a hound, but is not perceived by him till she has been up $1\frac{1}{4}$ minutes; she scuds away at the rate of 36 rods a minute, and the dog on view makes after, at the rate of 40 rods a minute; how long will the course hold; and what distance will the dog run? Ans. $14\frac{1}{4}$ minutes, he will run 570 rods?

198. A person who was possessed of $\frac{2}{5}$ of a vessel, sold $\frac{5}{8}$ of his interest for £375; what was the ship worth at that rate? Ans. £1500.

199. A man was hired for a term of 50 days on conditions, that for every day he worked he should receive 75 cents, and for every day he was idle he should pay 25 cents for his board; at the expiration of the time, he received $27,50, how many days did he work?

Ans. 40 days.

200. B and C purchased 1200 acres of land at one dollar per acre, each paying $600. Some time after, C on viewing it, offers to take a certain square piece at $1,75 per acre to the amount of his advance, to which B consents; how many acres will each have, what is the length of each side of C's lot, and what does B's part cost him per acre?

Ans. C has 342 acres, 3 roods, $17\frac{1}{7}$ rods.
B " 857 " 0 " $22\frac{6}{7}$ "
B's land is 70 cents per acre.
Side of C's = 234 rods 3 ft. $6\frac{3}{4}$ in.

201. Bought 36 pipes of wine for $4536; how must I sell it a pipe to save one for my own use, and sell the rest for what the whole cost? Ans. $129,60 cts.

202. Two drovers meeting on their way,
And thus they said—"'Tis true,
If half your flock you give to me
I'll have just eighty-two.
"Nay, friend," the other soon replied,
"Add but a third to mine
Of your best sheep—then I shall have
One hundred twenty-nine."

His answer was exactly true,
No scholar will impeach;
Then by your knowledge show to me
How many sheep had each?

Ans. A had 21.
B " 122.

203. The hour and minute hands of a watch are exactly together at 12 o'clock; when are they next together?

Ans. 1 hour 5 m. $27\frac{3}{11}$ sec.

204. If $\frac{5}{7}$ of $\frac{3}{8}$ of $\frac{4}{5}$ of a ship be worth $\frac{2}{9}$ of $\frac{7}{8}$ of $1\frac{2}{13}$ of the cargo, valued at £1000, what did the ship and cargo cost?

Ans. £1837 12s. $1\frac{2}{3}\frac{5}{9}$d.

205. A and B have the same income; A saves $\frac{1}{8}$ of his, but B by spending \$30 a year more than A, at the end of 8 years finds himself \$40 in debt, what is their income, and what does each spend a year?

Ans. Income \$200.
A spends \$175.
B " \$205.

206. Three parcels of beef, of 60 barrels each, were received at Baltimore from Boston, marked, viz: W. M. Y. The lot marked W. was found to be 50 per cent. better than the others. If the whole sold together at \$10 per barrel, how must the sales be adjusted between the owners of the beef?

Ans. Y's 60 bbls. at $\$8,57\frac{1}{7} = \$514,28\frac{4}{7}$.
M's 60 " " $8,57\frac{1}{7} = 514,28\frac{4}{7}$.
W's 60 " " $12,85\frac{5}{7} = 771,42\frac{6}{7}$.

180	\$10,00	\$1800,00

207. Just 16 yards of German serge
For 90 dimes had I;
How many yards of that same cloth
Will 14 eagles buy?

Ans. 248 yards, 3 qrs. $2\frac{2}{9}$ n.

208. A gentleman divided his fortune among his 3 sons, giving A 8 dollars as often as B 5, and C but 3 as often as B 7, yet C's share amounted to \$1200; what was the father's estate? Ans. \$8480.

209. There is an island 20 miles in circumference, and 3 men started together to travel the same way about it; A goes 2 miles per hour, B 4 miles per hour, and C 6 miles per hour; in what time will they come together again? Ans. 10 hours.

210. A man and his wife can drink a cask of beer in 12 days, but when the man is from home it lasted the woman 30 days, how many days would the man be in drinking it alone? Ans. 20 days.

211. The roof of a building with perpendicular front makes with the horizon an angle of 45 degrees, a leaden ball rolled from the apex thereof strikes the horizontal plane below 40 feet from the base of the front, but when rolled from the centre of the roof it strikes only 30 feet from the base. Required the heighth of the front and length of the roof?

Ans. 120 (front) feet 14,142 feet.

212. An iron ball rests upon three contiguous balls of the same diameter, fixed upon a horizontal plane, but if the iron ball be exchanged for one of the same material and double its diameter, the whole pressure upon the three balls will be increased 40 pounds. Required the diameter of each ball? Ans. 6,736 inches.

213. Two men, A and B, laid hold on a parcel of apples, and after devouring them discovered that A had eaten 15 apples more than B, A would have been 36 minutes eating B's apples, and B would have required 49 minutes to have eaten A's. Required the time they were eating and the number of apples, and how many were devoured by each?

Ans. { Time 42 minutes.
105 apples devoured by A.
90 " " " B.

214. Suppose a square yard containing 36 perches was enclosed, at one of the corner posts a horse was fastened by a line just long enough to reach round the enclosure. Required what quantity of land he could graze?

Ans. 1745,6 rods.

215. A and B purchased a farm containing 450 acres at *$6 per acre*, for which they paid equally, A getting the

part with the improvements agreed to pay $1 more per acre than B. How much land had each, and at what price per acre?

Ans. { A 's206+acres at $6,54+.
B's 243+ " " 5,54+.

216. Borrowed a sum of money at 8 per cent. simple interest, and lent it out again at 5 per cent., compound interest. When shall I gain the amount borrowed?

Ans. $30\frac{1}{2}$ years.

217. Three men, A, B and C, sent a ship to Cuba, with indigo, to the amount of $473344, A bought 250 cwt. 2 qr. 22 lbs., at $84 per cwt., B paid $70 per cwt. for his; but meeting with a storm at sea, they lost part overboard, A's proportional part cast overboard was equal to the $\frac{1}{100}$ part of the whole cargo, and $3\frac{2}{4}$ times the whole quantity cast overboard was equal to $3\frac{1}{3}$ times the whole cargo of A and B. When they came to land, A sold his remaining part for $126 per cwt., and found himself the loser of 10 per cent., besides charges B advanced the remaining part of his commodity 20 per cwt., and C gained $7 per cwt. by the quantity he sold. What did each person lose by this voyage, the charges whereof amounted to $15750?

Ans. { A's loss $2497,50.
B's " 90142,50.
C's " 47231,25.

218. A, in a scuffle, seized on $\frac{2}{3}$ of a parcel of sugar plums, B catched $\frac{3}{8}$ of it out of his hands, and C laid hold on $\frac{3}{10}$ more; D ran off with all A had left, except $\frac{1}{7}$ which E afterwards secured slyly for himself; then A and C jointly set upon B, who, in the conflict shed $\frac{1}{2}$ he had, which were equally picked up by D and E, who lay perdue, B then kicked down C's hat, and to work they all went anew for what it contained; of which A got $\frac{1}{4}$, B $\frac{1}{2}$, D $\frac{2}{7}$, C and E equal shares of what was left of that stock; D then struck $\frac{3}{4}$ of what A and B last acquired, out of their hands; they with difficulty recovered $\frac{5}{8}$ of it in equal shares again, but the other three carried off $\frac{1}{5}$ a piece of the same. Upon this they called a truce, and agreed that the

$\frac{1}{3}$ of the whole left by A at first should be equally divided among them. How much of the prize, after this distribution, remained with each of the competitors?

Ans. { A's part $\frac{2863}{26880}$. B's " $\frac{6335}{26880}$. C's " $\frac{2438}{26880}$. D's " $\frac{10284}{26880}$. E's " $\frac{4950}{26880}$.

219. A lad having got 4000 nuts, in his return home was met by mad Tom, who took from him $\frac{5}{8}$ of $7\frac{2}{3}$ of his whole stock; raving Ned lights on him afterwards, and forced $\frac{2}{5}$ of $\frac{5}{6}$ of the remainder from him, unluckily, positive Jack found him, and required $\frac{7}{10}$ of $\frac{17}{20}$ of what he had left; Smiling Dolly was, by promise, to have $\frac{3}{4}$ of $\frac{1}{4}$ of what nuts he brought home. How many then had the boy left? Ans. $575\frac{55}{64}$.

220. A and B have a certain number of dollars, says A to B, multiply the square root of your dollars by mine, and the number will be \$180, and says B to A, multiply the square root of your dollars by mine, and it will be \$150. Required the number of dollars of each?

Ans. { A's \$36. B's 25.

221. Laid out in a lot of muslin £500, but upon examination 3 parts in 9 proved to be damaged, so that I could make but 5s. per yard of it, and by so doing find I lost £50, at what rate per ell must I sell the undamaged part so that I may clear £50 by the whole?

Ans. 11s. $7\frac{2}{7}$d.

222. A and B together can perform a piece of work in 8 days, A and C together in 9 days, and B and C in 10 days. How many days will it take each person to perform the same work alone?

Ans. { A in $14\frac{34}{49}$ days. B " $17\frac{33}{41}$ " C " $23\frac{7}{31}$ "

223. I would plant 10 acres of hop ground, which must *be done either* in the square order, as the number 4 stands *on the dice,* or in the quincunx order, as the number 5;

the three nearest binds, in both cases must be set lineally just 6 feet asunder. How many plants more will be required for the last order than the first, admitting the form of the plot to lay the most advantageous for the plantation in either case? Ans. 1872 more.

224. A water tub holds 147 gallons, the pipe usually brings in 14 gallons in 9 minutes, the tap discharges it at a medium of 40 gallons in 31 minutes. Now these to be carelessly left open, and the water to be turned on at 2 o'clock in the morning, a servant at 5 finding the water running, shuts the tap, and is solicitous to know in what time the tub will be filled after this accident, in case the water continues to flow from the main?

Ans. 6 o'clock, 3 minutes $48\frac{2}{4}\frac{2}{3}\frac{8}{4}$ sec.

225. A, B, C and D agree to build a house; A, B and C can build it in 69 days, B, C and D in 87 days, C, D and A in 100 days, and D, A and B in 120 days, in what time would all four build it?

Ans. $67\frac{1}{2}$ days (nearly.)

226. In what time would each person build the above mentioned house alone?

Ans. A 304+ days.
B 209+ "
C 155+ "
D 3563+ "

227. A merchant in England can draw directly for 1000 piasters in Leghorn at 6 pence sterling per piaster, but he chooses to remit the same to Cadiz at 19 piasters for 7000 maravedies, thence to Amsterdam at 189 pence Flemish for 680 maravedies, and thence to Liverpool at 9 pence Flemish for 5 pence sterling. What is gained by this circular remittance, and what is the value of a piaster to him?

Ans. gain £28 14s., value 56-3,55.

228. A merchant in New York orders £500 sterling due him at London at 54 pence sterling per $ to be sent by the following circuit to Hamburg at 15 marks banco per £ sterling, thence to Copenhagen at 100 marks banco for 33 rix $s, thence to Bordeau at one rix $ for 6 francs, thence to Lisbon at 125 francs for 18 milrees, and thence to New York at $1\frac{1}{4}$ per milree. Did he gain or lose by

this circular remittance, and what was the arbitrated value of a $ by this remittance?

Ans. he gained, value of a $, 69 pence.

229. A gentleman sold a watch for $24, and gained as much per cent. as the watch cost him. Required the cost of the watch? Ans. $20.

230. A stationer sold quills at $1,50 a thousand, $\frac{1}{4}$ of which was profit. When they became scarce he raised the price to $2,25 per thousand. How much per cent. did he gain by the latter price?

$$\begin{array}{r} 150 \\ \frac{1}{4} \quad 37\frac{1}{2} \\ \hline 1,12\frac{1}{2} \end{array} \qquad \begin{array}{r|l} -225 & 100 \\ & 2- \\ & 225- \end{array}$$

100 per cent.

231. A fox starts 80 yards before a hound, and is not perceived by him till he has been up 45 seconds, he scuds away at the rate of 9 miles an hour, and the hound pursues after him at the rate of 18 miles per hour. In how many seconds will the hound overtake the fox, and how far will each have run?

The fox has 80 yards the start, we must see according to the conditions of the question, how many yards he has run in 45 seconds, thus:

$$\begin{array}{rrr|l} -4 & -20 & -60 & 45-\ 9 \\ & -2 & -60 & 1 \\ & & & 9-\ 3- \\ & & & 1760-\ 22 \end{array}$$

198 Ans.
80 the start.

Advance before the hound starts 278

Let us now ascertain in how many seconds the hound will gain 278 yards and overtake the fox?

$$\begin{array}{rrrr|l} 11 & -22 & -44 & -1760 & 278-\ 139 \\ & & -3 & -9 & 60-\ 2- \\ & & & & 60-\ 20-\ 5 \end{array}$$

11 | 695 = 63 $\frac{2}{11}$ seconds, Ans.

Finally, we have to ascertain how many yards the hound has run in $63\frac{3}{11}$ seconds.

—11	695— 139
—5 —20 —60	18— 3—
—60	1760— 16— 4
	556 Ans.

556 yards the hound has run.
The fox had 80 " the start.

476 yards the fox has run.

232. A wall is to be built 80 feet long, 45 feet high, and $2\frac{1}{2}$ feet thick. How many bricks will it take, if each brick is $4\frac{1}{2}$ inches in length, 4 inches broad, and $2\frac{1}{2}$ thick?

	80— 20
	45—
—2	5
	1728
—9	2—
—4	
—5	2
	345600 bricks, Ans.

233. A wall of 80 feet in length, 45 feet high and $2\frac{1}{2}$ feet thick, has been built with 345600 bricks, of 4 inches broad and $2\frac{1}{2}$ inches thick. What was the length of each brick in inches?

—4	2—
—5	80— 2—
	12—
—345600	45— 9
—2880	12—
—240 —2	5—
2 —10 —20	12—
2	9=$4\frac{1}{2}$ inches, Ans.

234. Suppose a wheel of 45 feet diameter, turns 10 times round in one minute, having a similar wheel on the other end of its shaft, which runs in a wheel of 6 feet

diameter, on whose shaft is a wheel of 30 feet diameter, which runs in a wheel of 8 feet diameter, which has a shaft with a wheel of 15 feet diameter, which runs in a wheel of 5 feet diameter, which also has a shaft holding a wheel of 12 feet diameter, which runs into one of 3 feet diameter. How often will the last wheel, of 3 feet diameter, turn round in one minute?

		—3	12—	2—
		—5	15—	
—2	—4	—8	30—	15
		—6	45	
			10—	5

3375 times per minute Ans.

235. A, on preparing for a voyage to Calcutta, purchased of G specie dollars to be paid in 18 months with interest. Supposing the premium on the dollars to be 3 per cent., and that G would have a compensation of 5 per cent. per annum for the use of his money, to be inserted in the note, which was given for $22145; I would know the sum purchased? Ans. $20000.

236. Two merchants, B and C, trade together; B advances $5000, and at the end of 4 months, being pressed for money to answer a demand, he takes out a certain sum, leaving the remainder to continue 8 months; C advances $2500, and at the end of 5 months he finds it necessary to put in $3000 more, and continues the whole 7 months longer, when they close their business, and B finds he has gained $1066⅔ and C $1333⅓, I would know how much B took out at the end of 4 months?

Ans. $2400.

237. G bought and sold for cash the following lots of flour, viz.; Jan. 1st he bought 50 bbls. at $5,75 per bbl.; on 15th, 20 bbls. at $5,60; on 16th he sold 65 bbls. at $6,25; on 17th he bought 10 bbls. at $6,75; June 5th he bought 16 bbls. at $5,50; and on the 19th, 19 bbls. at $6,80; on the 5th August he bought 30 bbls. at $6,50, and on the 25th he sold 68 bbls. at $6,60; Sept. 12th he bought 43 bbls. at $5,80; on 15th he sold 10 bbls. at $6, *and, on 18th,* 30 bbls. at $5,60; on 5th Oct. he bought 15 *bbls at $6,* and on 24th he sold 20 bbls. at $6,12½. How

many barrels has he on hand, and what is his gain or loss, estimating what remains at $6,25 per barrel?

Ans. 10 bbls. gain $49,45.

238. Two carpenters, A and B, who have each an apprentice, engage to finish a piece of work for $630. By agreement between them, A's apprentice is to be allowed 62½ cents per day, and B's 100 cents. When the work was finished, it appeared that A worked 120 days, and his apprentice 100; B worked 96, and his apprentice 135⅓ days. Supposing that, while doing the work, they receive each $210, what is each person's share of the remaining payment, on stating their accounts?

Ans. A $92,50 due.
B $117,50 "

239. James and John have lived together 8 years in John's house, the rent of which is stated at $50 per annum. James's bill for supplies is $1546,46, and John's bill $497,24, and he has James's note for $560,80, without interest. Required, the balance on stating their accounts, and in whose favor? Ans. $236,19 due John.

240. On 1st of May B of Boston had of H of Lowell 10 bbls. of flour at $6,75 cts. per bbl., and paid him in part $25 in cash. On 15th he had of H 31 gallons of molasses at 30 cts. and a bbl. at 83 cts.; 19th he delivered to H 30 qtls. of fish at $2,50 cts., and took 20 yards of baise at 50 cts.; June 3d, B had 250 lbs. of coffee at 24 cts., and 10 lbs. of chocolate at 25 cts.; July 27, B brought to H 4 bbls. of oil at $10, and 31st he sent to H 4 bbls. salmon, at $10,50 cts., when H paid his order to J. M. for $12,50 cts., and delivered per his order to D. L. 903 lbs. of sugar at 7 cts.; Sept. 6th, A paid B's note to G for cordage, on which H was endorser, viz., for principal, $65,94 cts., $1,87 cts. for interest. On 10th B brought to him 5854 feet of boards, at $11,50 cts. per thousand, and 10 barrels of No. 1 mackerel, at $5; a settlement was then made, and he was furnished with his account, and the balance paid in cash. What was the amount, and in whose favor?

Ans. $5,67 cts. in favor of B.

241. A, B, and C agreed on an entertainment, to which some friends were invited; A and B supplied the provi-

sions, &c., in 8 baskets of equal cost, five of which were supplied by A and three by B. When the entertainment was finished, C laid down $12,64 cts. for his part, which was to be shared by A and B; but disagreeing in the division of it, they referred it to D, who awarded to each his part, and provide the justness of his decision by stating it in an account. Required, the amount awarded to each?

Ans. { A $11,06 cts. / B 1,58 "

242. A person, failing in trade, owed to A $100, B $200, C $400, to D $350; and his property consisted of

33½	yards	Broadcloth, worth	$5,75 cts.	per yard.
57⅜	"	Cassimere, "	2,46	"
136⅞	"	Linen, "	,86	"
229¾	"	Flannel, "	,38	"
58	lbs.	Tea, "	1,20	per lb.
254	"	Sugar, "	,09	"
5	bbls.	Flour, "	5,75	per bbl.,

which was assigned for benefit of his creditors. The commission on sale of the goods, at the appraised value, was at 2½ per cent., and the assignee's bill $43,50 cts.; on exhibiting their statement to the creditors and paying the dividends, how much was there paid to each, and how much did he pay on the dollar?

Ans. { To A $57,14 cts. / " B 114,29 cts. / " C 228,57 cts. / " D 200,00 cts. } 57⅐ cts. on the dollar.

ERRATA.

Page 21, 1st line, for 17 read 19.
" 25, 6th line from the bottom, for 36,000 read 36,900.
" 56, 23d line from the top, read × instead of +.
" 57, 7th line from the bottom, read × instead of +.
" 59, 11th and 12th lines from the top, read × all five of them. These are all signs of multiplication, instead of addition.
" 63, 4th line from the top, for 49 read 49—.
" 64, for + read ×.
" 67, 8th line, Ans., for 2 read 1½.
" 67, 26th Example, for $\frac{10}{11}$ read $\frac{10}{12}$.
" 66, the 27th Example on this page belongs at the bottom of page 67.
" 71, 3d line from the bottom, for 3 read —3.
" 72, 4th line from the bottom, for 3 read 3—.
" 73, 5th Example, read $\frac{8}{11}$
" 74, 3d line from the top, for 2— 6 read 0—.
" 80, 2d line from the top, read 4$\frac{4}{5}$ yards cost.
" 84, 2d line from the top, read $\frac{8}{9}$ of the cargo.
" 89, 123d Example, read $\frac{4}{6}$.
" 105, 3d line of 2d Example, for 96— 50— read 9650—.
" 106, 5th line of 6th Example, read $\frac{7\,19}{10}$.
" 115, 1st Solution, read × × ×, and 840 instead of 746.
" 126, 2d line from top, read Tare and Tret are.
" 153, 3d Ex. 5th line, read 1210— instead of 12,1— 0—.
" 201, 11th line from the bottom, instead of 3 read 8.
" 207, 31st Ex. 9th line, instead of 26,876, read 26,776.
" 212, 10th line from the top, instead of 3, " 01, 335, read at 03, 01, 335.
" 233, 217th Example 2d line, for 2 qr. read 1 qr.